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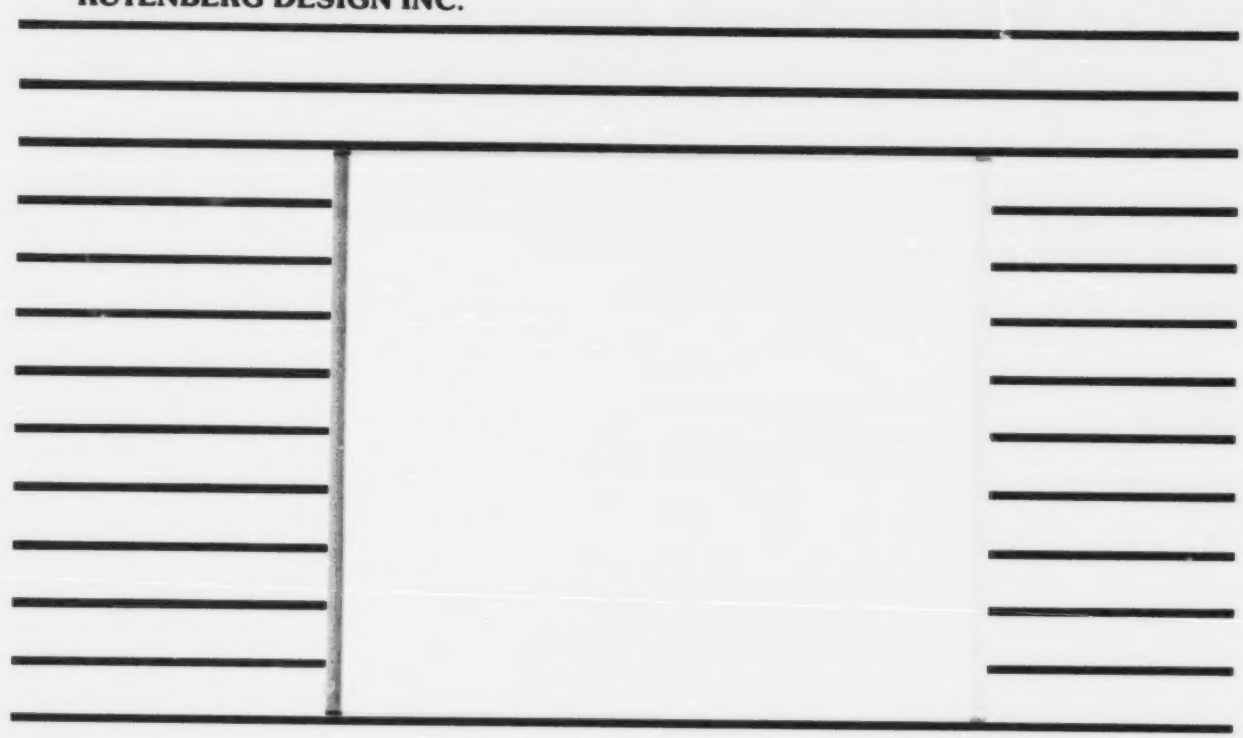

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PORTABLE TRAIN BASED WHEELCHAIR LIFT DESIGN

for

Transportation Development Centre
Transport Canada

by

RUTENBERG DESIGN INC.

January 1987

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PORTABLE TRAIN-BASED WHEELCHAIR LIFT DESIGN

PREPARED FOR:
TRANSPORTATION DEVELOPMENT CENTRE
OF TRANSPORT CANADA

BY
Uwe Rutenberg
Dirk Mietzker
RUTENBERG DESIGN INC.

JANUARY 1987

DISCLAIMER

The contents of this report reflect the views of RUTENBERG DESIGN INC. and not necessarily the official views or opinions of the Transportation Development Centre of Transport Canada.

Un sommaire en français de ce rapport est inclus avant la table des matières.

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17. Abstract

This report describes a portable train-based wheelchair lift designed for VIA Rail Canada to make trains accessible to wheelchair users and other travellers who have difficulty negotiating stairs. A central double beam is positioned with one end at the top of the stairs in the stairwell of the train and the other at station level. A platform connected to the beam can carry one manual, electric or special wheelchair up to 63.5 cm (25") wide and 1.22 m (48") long, or two standing passengers. The maximum load is 227 kg (500 lb). The wheelchair is secured by one front and two rear guard panels. The electrical power to move the platform is drawn from the train. A full scale mock-up was built to simulate functional and operational aspects. The mock-up successfully achieved boarding/deboarding time specification of two minutes. The final design, however, many require modifications to stay within the weight limits of 13.6 kg (30 lb) established by VIA Rail.

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17. Résumé

Ce rapport concerne l'élévateur embarqué destiné à rendre les trains VIA Rail accessibles aux personnes en fauteuil roulant ainsi qu'à tous les voyageurs éprouvant des difficultés à monter ou descendre un escalier. L'élévateur comporte une flèche centrale double s'étendant depuis le haut de l'escalier du train jusqu'au niveau du quai, ainsi qu'une plate-forme mobile pouvant accueillir un fauteuil roulant manuel, électrique ou autre, ayant jusqu'à 63,5 cm (25 pouces) de large et 1,22 m (48 pouces) de long, ou deux personnes debout. La capacité maximale est de 227 kg (500 lb). Une rampe à l'avant et deux à l'arrière maintiennent le fauteuil immobile. Le dispositif est raccordé au circuit électrique du train. Une maquette en vraie grandeur a été réalisée afin de mettre en évidence les caractéristiques techniques du dispositif qui, lors des essais, a pu respecter dans les deux sens le temps de manoeuvre fixé, à savoir 2 minutes. Toutefois, il faudra le modifier quelque peu pour respecter une autre exigence de VIA Rail, à savoir une tare maximum de 13,6 kg (30 lb).

18. Mots-clés	19. Diffusion
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SUMMARY

In 1985 a contract was awarded to Rutenberg Design Inc. by the Transportation Development Centre to carry out the design and development of a portable on-board wheelchair lift for use on VIA Rail trains. A feasibility study undertaken for VIA Rail Canada in 1984 by Rutenberg Design Inc. identified two locations for storing a compact foldable device on-board: in the vestibule or behind the bulkhead.

Technical performance requirements for the use and operation of the device were established by VIA. These included load capacity of 227 kg, a two-minute operating time, maximum weight of 13.6 kg, and operation by a single attendant. The designers established user requirements of the target passenger group. Three potential design concepts were developed and evaluated.

In the first concept, the lift consists of two beams placed at the extremes of the stairwell, extending from the vestibule level to the station level. Two drive mechanisms move a cantilevered platform from train level to station level, while maintaining its parallel position. The advantage is an almost clear stairway for the VIA agent, allowing him to walk in front or behind the ascending or descending platform. The disadvantage is the anticipated difficulty of synchronizing the two drive mechanisms and leveling the two beams.

In the second concept, the same platform principle was evaluated, using one off-centre beam. This concept would provide maximum space for the agent on the stairs, but would require a very strong and therefore larger lift platform carriage.

The third and final concept is a combination of the first two designs. It uses a central double beam with one drive mechanism and a cantilevered platform, providing strength and rigidity as well as manoeuvring space for the VIA agent. This concept promised to offer the best compromise between technical, operational and user requirements, including the specification for a two-minute dwell time. Shop drawings were prepared and one full-scale mock-up, including folding and storage features, was built.

The mock-up was demonstrated in simulated storage and operational positions on LRC, RDC and blue cars in VIA Rail's Pointe-St-Charles yards in Montreal. The simulated demonstration concluded that the dwell time of two minutes appeared to be feasible. However, it could not be determined at this mock-up stage whether the lift would meet the 13.6 kg weight limitation set by VIA.

SOMMAIRE

En 1985, le Centre de développement des transports a confié à la firme Rutenberg Design Inc. la tâche d'étudier et de réaliser un élévateur de fauteuils roulants destiné aux trains VIA Rail. En 1984, dans une étude de faisabilité effectuée à la demande de cette société d'Etat, le contractant avait proposé deux emplacements pour ranger un dispositif embarqué escamotable: sur la plate-forme de la voiture ou bien derrière la paroi intérieure.

Les exigences formulées par VIA Rail à l'égard de ce dispositif et de son fonctionnement étaient les suivantes capacité de charge: 227 kg; temps de manoeuvre en charge: 2 minutes; tare maximum: 13,6 kg; nombre de préposés: 1. Quant aux besoins des utilisateurs, le contractant les a déterminés en consultant un groupe cible. Trois variantes ont été étudiées et évaluées.

Dans la première, le dispositif comportait deux flèches, chacune à une extrémité du puits d'escalier, s'étendant du niveau de la plate-forme jusqu'à celui du quai. Une plate-forme en porte-à-faux maintenue horizontale était mue par deux mécanismes d'entraînement. L'avantage de cette variante était de dégager presque totalement l'escalier, permettant au préposé de monter ou de descendre en même temps que la plate-forme mobile. L'inconvénient résidait dans l'obligation de synchroniser la marche des deux mécanismes et de garder les deux flèches au même niveau, ce qui ne pouvait se faire sans quelques difficultés.

La deuxième variante faisait appel à une seule flèche excentrée. Elle avait l'avantage de dégager l'escalier mais au prix d'une flèche plus robuste et donc plus largement dimensionnée.

Quant à la troisième, elle combinait les deux précédentes, c'est-à-dire qu'elle utilisait une flèche centrale double et qu'elle comportait un seul mécanisme d'entraînement, apportant robustesse et rigidité tout en donnant au préposé assez d'espace pour manoeuvrer. Cette variante promettait d'offrir le meilleur compromis entre les exigences techniques et fonctionnelles et celles des utilisateurs, tout en respectant la prescription d'un temps de manoeuvre de 2 minutes. Les dessins d'exécution ont été faits et une maquette en vraie grandeur, repliable et escamotable, a été réalisée.

Les essais de la maquette ont eu lieu dans les ateliers de VIA Rail à Pointe-St-Charles à Montréal; ils mettaient en évidence les caractéristiques de manoeuvre et d'escamotage sur une voiture LRC, un autorail diesel et une voiture de type ancien. Ces essais ont montré qu'un temps de manoeuvre de 2 minutes était bel et bien réalisable; toutefois, ils n'ont pu permettre de déterminer si le dispositif opérationnel respecterait la limite de 13,6 kg imposée par VIA Rail.

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1.0 INTRODUCTION

1.1 Background

Since the inception of VIA Rail's Program in 1981 for Special Need Passengers, the problem of boarding wheelchair passengers has remained unsolved. Wheelchair accessibility to rail cars is a problem at all VIA Stations except Montreal's Central Station which has raised platforms. At present VIA operates 20 manual mechanical and one electrical station-based lifts in major stations across Canada. Manual operations is slow and tedious - many attendants prefer to carry the passenger on board. Currently, at all small stations and at most larger stations, it is necessary to manually board a wheelchair passenger. The concept of a light-weight, portable, on-board wheelchair lift, which could be easily stored and operated by one attendant, was conceived and proposed by RUTENBERG DESIGN in an unsolicited proposal to DSS in 1982 (D-239). In 1985, VIA requested TDC to undertake the project on their behalf.

The purpose of this study was to resolve the problems of boarding wheelchair passengers to VIA Rail cars by means of a wheelchair lift device.

The objective of this phase of the project was to develop a concept and build a full scale mock-up in order to assess its validity. If successful, a prototype would be built and tested in Phase II and III.

The lift was to be both train-based and station-based and must be operated by one person.

In an earlier feasibility study by RUTENBERG DESIGN INC. various storing possibilities of a foldable lift device on board different train types were identified either in the vestibule area or behind bulkheads.

1.2 Methodology

The project was proposed in three phases; Phase I to be carried out and sponsored by the Transportation Development Centre of Transport Canada. Phases II and III, sponsored by VIA Rail Canada, would follow.

The study team examined data from a previous feasibility study for possible on board storage space of a foldable device. Technical and operational requirements were provided by VIA Rail. Using its own data regarding specific user/passenger requirements, the designers, through sketches and small conceptional models, proposed a variety of solutions which were examined and evaluated against established criteria.

Three main approaches were proposed, from which one final concept was selected. This concept was then built as a full size cardboard model to verify dimensions, operational and technical aspects. After evaluation by the design team, this concept was built as a final mock-up in wood and metal to simulate appearance, dimensions and some operational and user aspects. This mock-up was placed in different trains in Montreal and successfully presented to TDC and VIA Rail authorities.

From this study two main criteria were established as the most important factors for VIA Rail and the design team - a) not to exceed 13.6 kg (30 lbs) of weight per single component for handling, and b) the critical dwell time of 2 minutes for use in a given station.

At the present stage, main emphasis was given to staying within the limits of the dwell time, which might not fulfill the request for 13.6 kg (30 lbs) component weight.

If both weight estimations and dwell time have to be equally met, the concept has to be modified substantially, with changes in the staircase of the cars or a different approach to the portability of the lift.

1.3 Constraints

At this point in time the design team had to take into account the following limitations in the equipment:

a) Outside handles on some cars (blue cars) protrude into staircase, reducing clearance to 635 mm (25"), a standard manual wheelchair measures 635 mm (25").

b) Height dimensions from station platform to vestibule platform can vary from 1.14 m - 1.40 m (45" - 55").

c) Station platforms are often not level and consist of gravel only.

d) Irregularities in the station platform can vary from 25 mm - 75 mm (1" - 3") within 1 m (39").

e) Stairway angles and stair dimensions vary in different cars.

f) Left and right staircases are not symmetrical.

g) Blue cars, stainless steel cars and RDC's have flip doors which should be kept clear.

h) Electrical power supply is 110V AC for LRC and 110V DC for RDC's and blue cars.

i) On LRC fleet, next car to accessible car has to be boarded, since accessible washroom and tiedown are on that end of the car which has no door.

j) Blue cars and stainless have 5 cm (2") high threshold from vestibule to inside of car and a door clearance of 475 mm (22").

k) No storage is allowed in vestibule of RDC area because driver position is unpredictable.

l) Little or no modification should be made to staircase of cars for lift installation except for power supply receptacles.

m) VIA would provide storage box for lift in trains with lock.

2.0 AGENT CHARACTERISTICS

2.1 General

a) One person, male or female, would operate the wheelchair lift and be responsible for it from the moment of pick-up from storage until its return.

b) The agent must have complete control over the situation and a good understanding of wheelchair passenger requirements.

c) The agent can be male or female, ranging from 20 years to 60 years of age.

2.2 Operating Conditions

Operation will take place: in the train behind the bulkhead, the corridor to the vestibule, in the vestibule, in the staircase and on the station platform in front of the car door. This requires maneuvering in tight quarters inside the car and exposed operation outside the car. Operating conditions include: warm temperatures inside, cold, rainy, windy and snowy conditions outside; operation by day and night, under natural and artificial light conditions. Agent requires heavy warm clothing in winter, eg. coat, hat, gloves, boots during operation. Stairways in winter might be filled with snow, be icy and/or slippery.

2.3 Agent Requirements

1. Agent must be physically able to tip backwards a typical passenger (average 75 kg (190 lbs) with heavy clothing) in a wheelchair to place weight over the axle and pull passenger with wheelchair up a small ramp to platform of lift.
2. He/she must understand and be aware of simple motor driven equipment and have an understanding of its control and operating limitations.
3. Weight of single components to lift, push, or pull should not exceed 13.6 kg (30 lbs).
4. Strain, fatigue and static muscular efforts should be avoided for operation.
5. Preferable operation is from standing position. Bending should be done with knees bent, not back bent.
6. Operation of lift should be easily understandable through symbols and color coded controls to avoid re-learning process.
7. Controls should be positioned by priority and sequence of operation.
8. Cold and dirty surfaces should be avoided for direct hand or finger contact.
9. Agent should get refresher and hands-on training at regular intervals.
10. Agent has time to prearrange lift device before train arrives at station and after it leaves station.
11. Dwell time for direct boarding/deboarding should not exceed 2 minutes.

12. Agent will have key to lock for storage of lift and must report inefficiency of lift device immediately.

3.0 PASSENGER CHARACTERISTICS

3.1 General

Wheelchair users can have a great variety of physical abilities and disabilities. The equipment they are using ranges from a standard manual wheelchair to a wider manual converted wheelchair (with electric motors and batteries), to sports wheelchairs (with negative wheel angle and therefore very wide wheel distance), to scooter type wheelchairs (mainly three wheeler with batteries and pivoting seat), to four wheel electric scooters.

3.2 Specific Characteristics - Wheelchair Users

There are five main causes why a person is using a wheelchair.

3.2.1 Arthritis: Inflamation of joints make walking painful or impossible. Use of hands, arms and fingers can also be painful.

3.2.2 Multiple Sclerosis: An organic nervous disease which can paralyse and limit movement in different parts of the body. All four limbs can be affected and balance, coordination and support can be difficult.

3.2.3 Quadraplegia: Paralysis - little or no control of upper and lower limbs.

3.2.4 Paraplegia: Paralysis - little or no control of lower limbs.

3.2.5 Hemiplegia: Paralysis - partial or no control on one side of body. This group is using the wheelchair constantly and can usually not transfer to another seat or chair without physical help of others.

3.3 Specific Characteristics - Elderly

This group is limited in their mobility and often asking for a wheelchair as a means to overcome long distance in a terminal.

3.3.1 Their walking requires more effort, they often take smaller steps and have to rest.

3.3.2 Reaction time can be slower.

3.3.3 Often walk with head down, spine flexed and knees slightly bent.

3.3.4 Have reduced agility, stamina and balance.

3.3.5 Strength and ability to grasp are reduced.

3.3.6 Hearing and seeing can be reduced by 20-30 percent.

3.3.7 Body height can be smaller than average person.

This group requires good support for their hands and a steady surface to stand on.

3.4 Crutch Users

The crutch user supports most of his body weight on one or two crutches. If two crutches are used they are spread away from the passenger, and therefore require more lateral space.

Non-slip surfaces required. Clearance to walk must be 92 cm (40").

3.5 Cane Users

The cane user requires a cane more for balance than for supporting his weight. Many cane users bend their upper body forward and use small steps when walking. Their vertical equilibrium cannot be changed very much.

Steady and non-slippery surfaces are required for feet and cane. Lateral clearance 56 cm (22") for walking.

3.6 Walker User

The walker user supports some of his weight through both arms onto the upper walker handle bar. He then shifts his weight by pulling the walker up and in front, momentarily taking his body weight off the walker.

Walker requires 71 cm (28") clearance for walking and steady surface conditions.

3.7 Psychological Factors

For the use of any lifting device this group of passengers perceive comfort and ride quality as smooth and steady movements without sudden jerks, a minimum of contact with the equipment, unless intended, and the appearance of safety. Equipment movements should be predictable so that passenger can prepare him/herself. No exposed moving parts should be in the vicinity of the passengers reach or action. Passengers do not want physical contact with agent and prefer being told by the agent in short terms what procedures to expect.

The equipment should not resemble clinical, stigmatized handicapped appearances, nor heavy construction equipment.

4.0 AGENT - PASSENGER INTERFACE REQUIREMENTS

The passenger is in the hands of the agent, has little or no control of events and depends completely on the agent for boarding and deboarding. Anxiety and uncertainty must be minimized by the agent by positive attitude, knowledge of passenger requirements and concise notice of which procedures will occur.

Agent must avoid intimidating or patronizing the passenger. Agent should respect the passenger's physical territory and avoid physical contact. Passenger should be helped in a dignified manner.

5.0 TECHNICAL REQUIREMENTS

A complete detailed copy of technical requirements established by VIA Rail is included as Appendix B.

These are the most important aspects:

5.1 Capacity

The lift shall be able to accommodate the range of three and four wheel motorized wheelchairs with an attendant. The payload capacity shall be 295 kg (650 lbs).

This requirement was changed during the course of the development to a payload of 277 kg (500 lbs) and the wheelchair passenger only. In case of an elderly, crutch or cane user, two people can board the lift platform. VIA also concluded that in case of a very heavy wheelchair and (eg. 136 kg (300 lbs)) a very heavy passenger (eg 136 kg (300 lbs)) the wheelchair would be lifted separately and the passenger be transferred into VIA's own on-board narrow wheelchairs.

The lift shall be capable of handling height differentials of up to 1.52 m (60") highest vehicle floor level to top of tie(TOT.)

5.2 Environment

The lift and its operation shall be unaffected by snow, salt or cold weather. During storage, it shall be able to withstand vibrations and such loads as specified by VIA Engineering.

The lift, complete, and as subassemblies, together with its mechanisms, shall be able to withstand the occasional impact load resulting from a fall from the height of 76 cm (30") onto a steel or concrete floor without permanent deformation or degraded performance.

5.3 Power Source

This requirement was changed from 110 V AC and DC and 64 V DC to 110 V AC and 110 V DC only. The maximum current draw including start-up shall not exceed 12 amps. Power cable should be rated outdoor for 120 volt, 20 amp service.

5.4 Controls

There shall be a control box which shall permit operation of a lift from either the passenger car vestibule or from track side.

5.5 Interface

The lift shall interface with the passenger car vestibule and stairwells without imposing any structural modifications or undue stress on the car body. It shall remain rigid and immobile while the lift is in operation.

The lift shall accommodate uneven terrain and various degrees of car body cant. It shall interface with the complete range of station platforms that VIA has (with the exception of Central Station, Montreal).

5.6 Codes

The lift shall conform to the following CSA standards:

CAN 3-B355-M81 - Safety Code for Elevating Devices for the Handicapped.

C22.1-1982 - Canadian Electrical Code.

5.7 Operating Requirements

To facilitate storage, assembly and positioning of the lift one sub-assembly supplied may not exceed 13.5 kg (30 lbs).

The maximum allowable time for one employee to assemble the lift shall not exceed 5 minutes.

The maximum allowable time for one employee to:

a) position the lift (while train is stopped at station).

b) effect a complete up and down cycle with the rated payload including loading and unloading.

c) remove the lift and prepare the vestibule for train departure, shall not exceed a total of 2 minutes.

The maximum allowable time for one employee to unfold the lift as required and secure it in its stored position shall not exceed 5 minutes.

5.8 Anti-Roll Off Restraint

The lift platform shall provide safety features for the wheelchair to prevent it from rolling off and sliding off, ensuring also the safety feeling of the passenger sitting in it.

5.9 Storage

The lift, either as an integral device or by means of assemblies, shall be capable to being stored on- board the vehicle in a space not to exceed 56 cm x 125 cm x 12 cm (22" x 49"x4.75").

This was changed to a storage space behind bulkheads of approximately 76 cm x 122 cm x 30 cm (30" x 48" x 12").

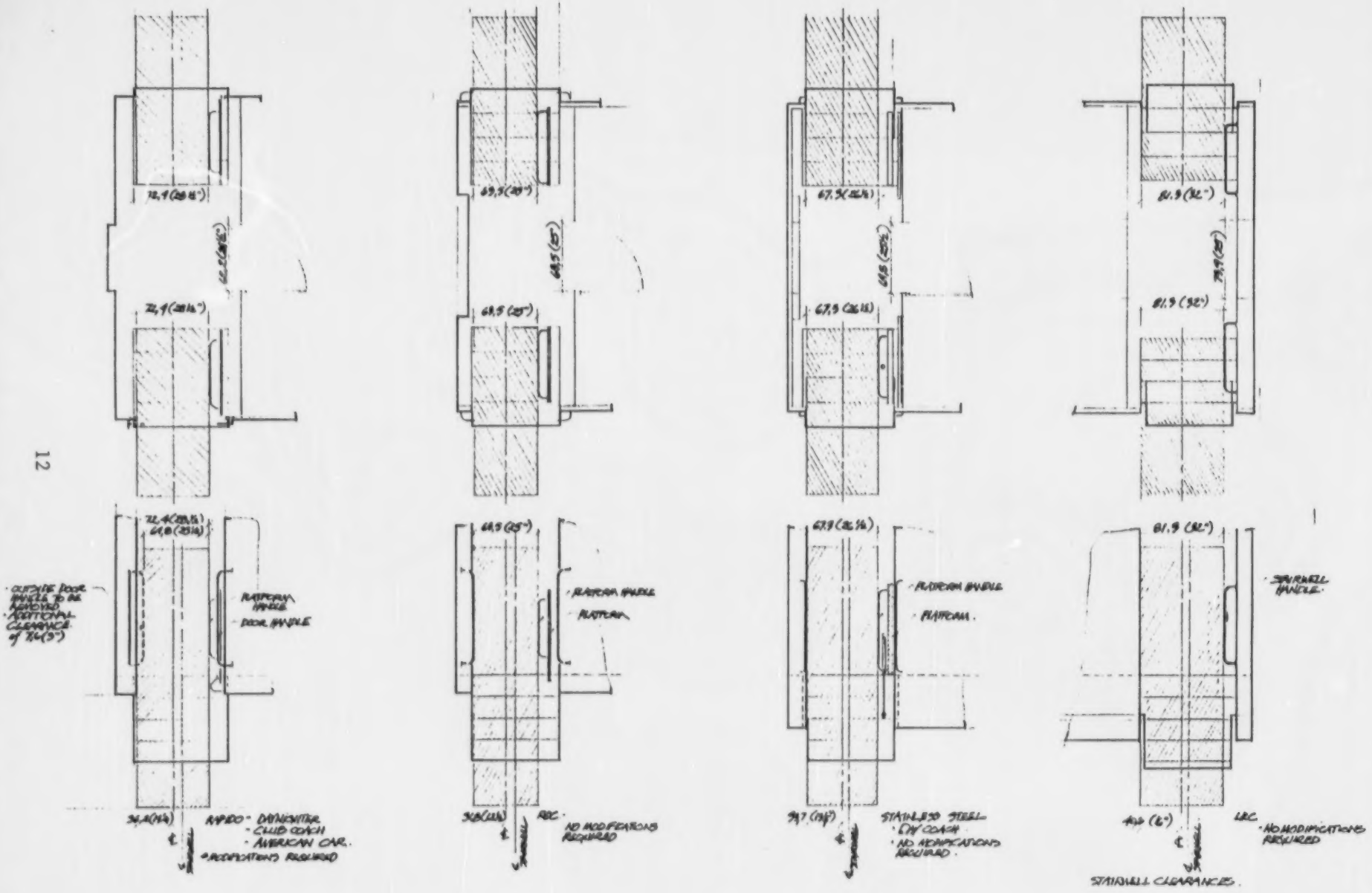

Fig. 1 Door clearance for typical cars

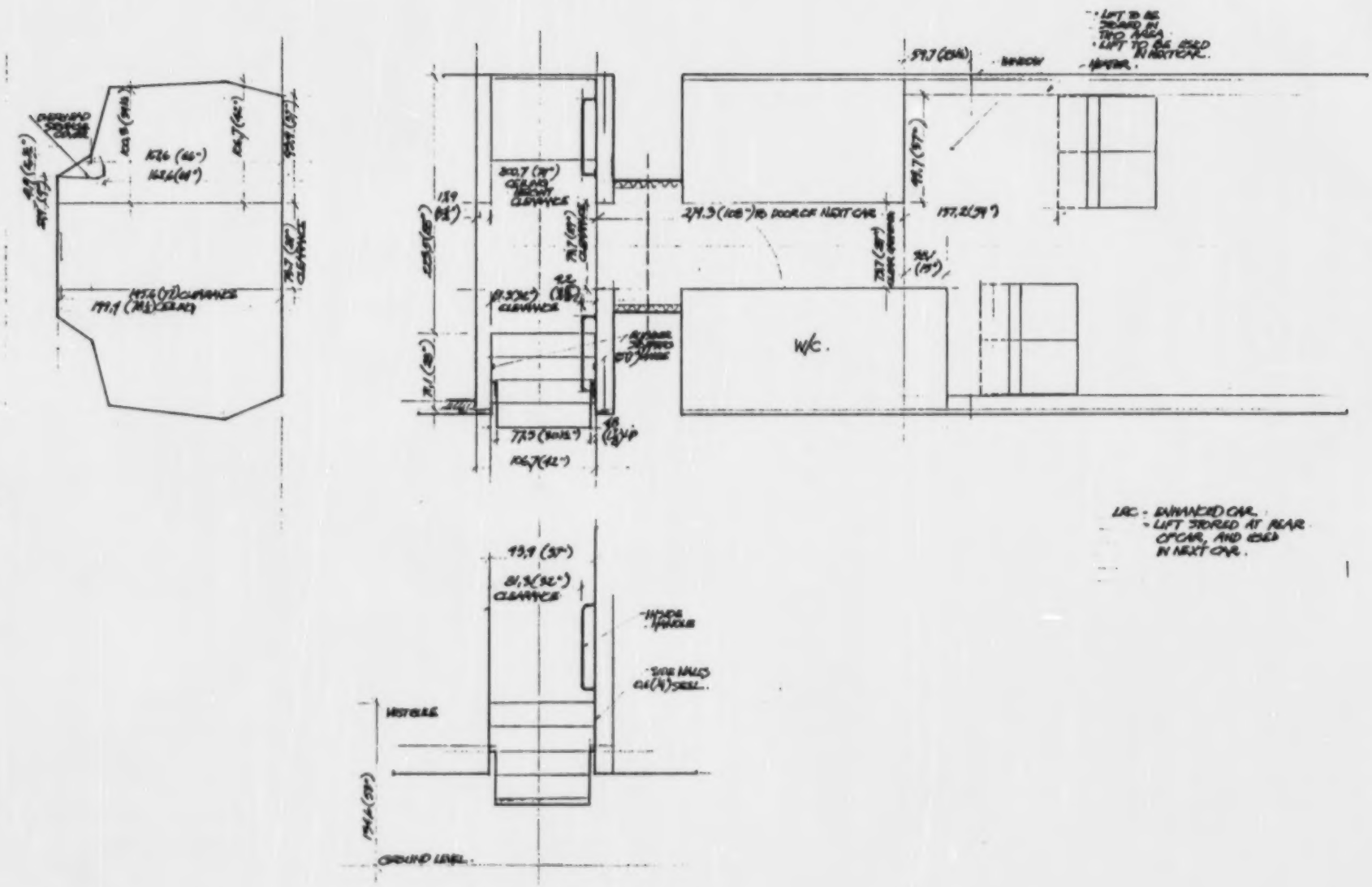

Fig 2. Vestibule and storage space (LRC)

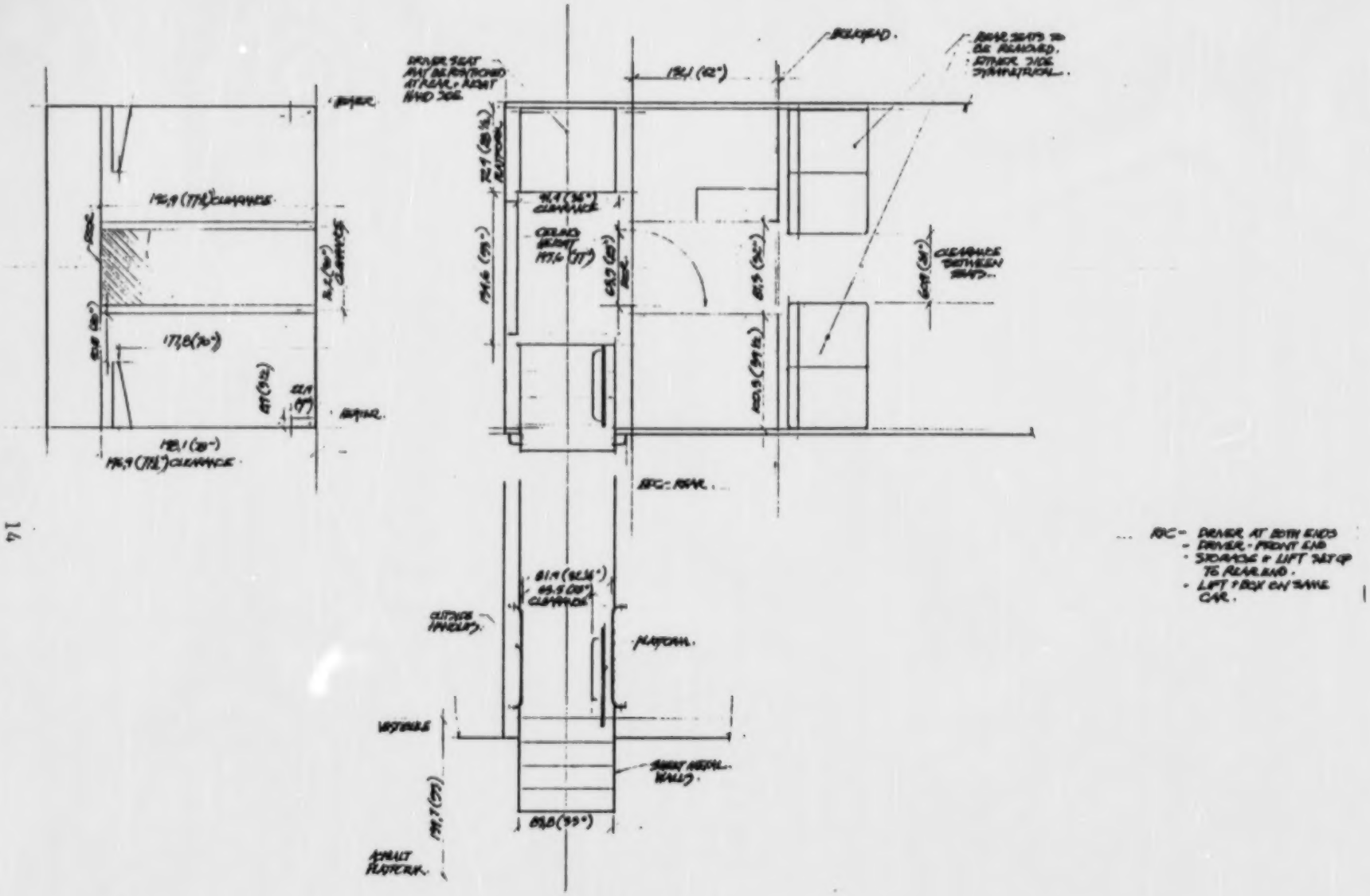

Fig. 3 Vestibule and storage space (RDC)

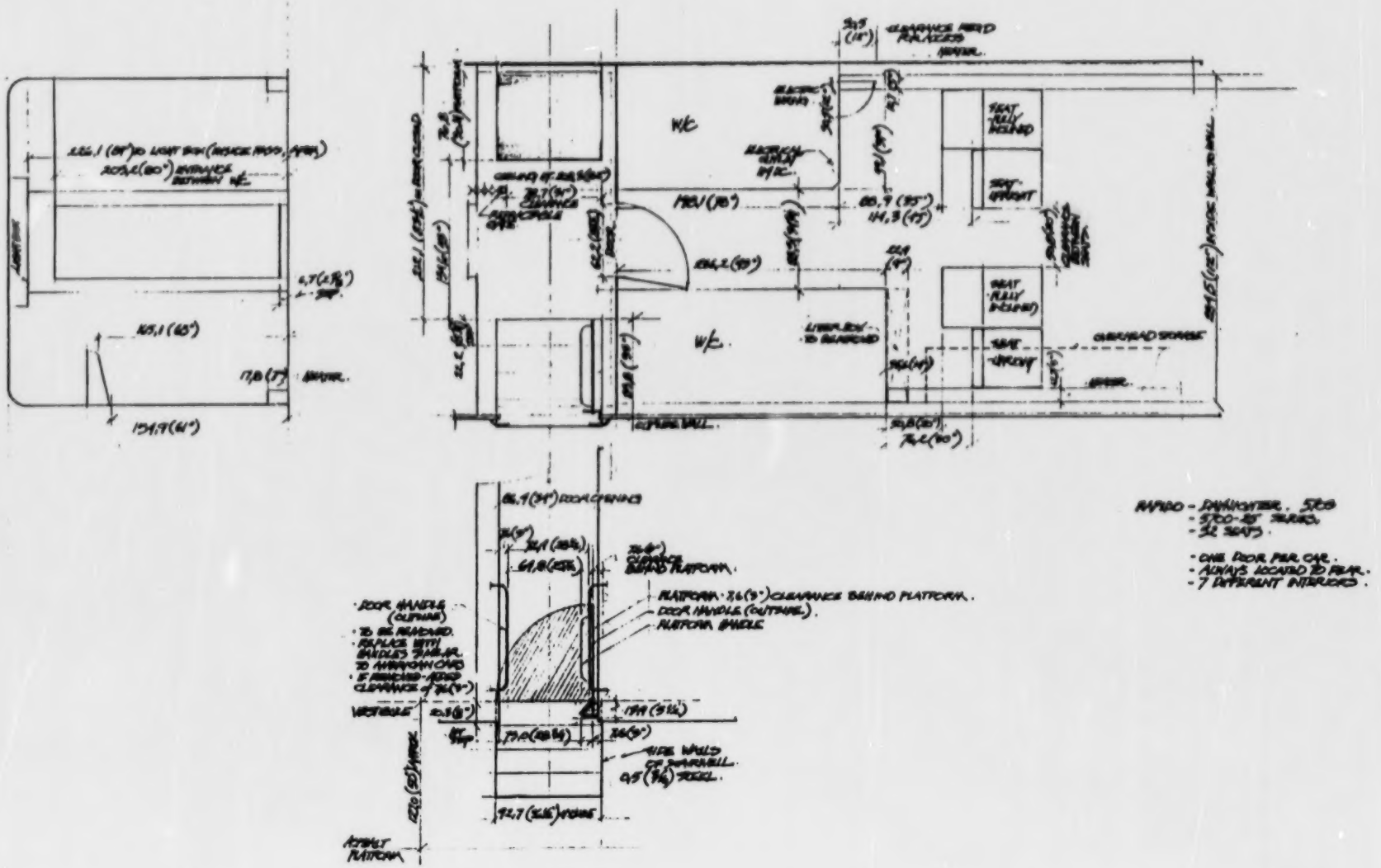

Fig. 4 Vestibule and storage space (Rapido - Blue Cars)

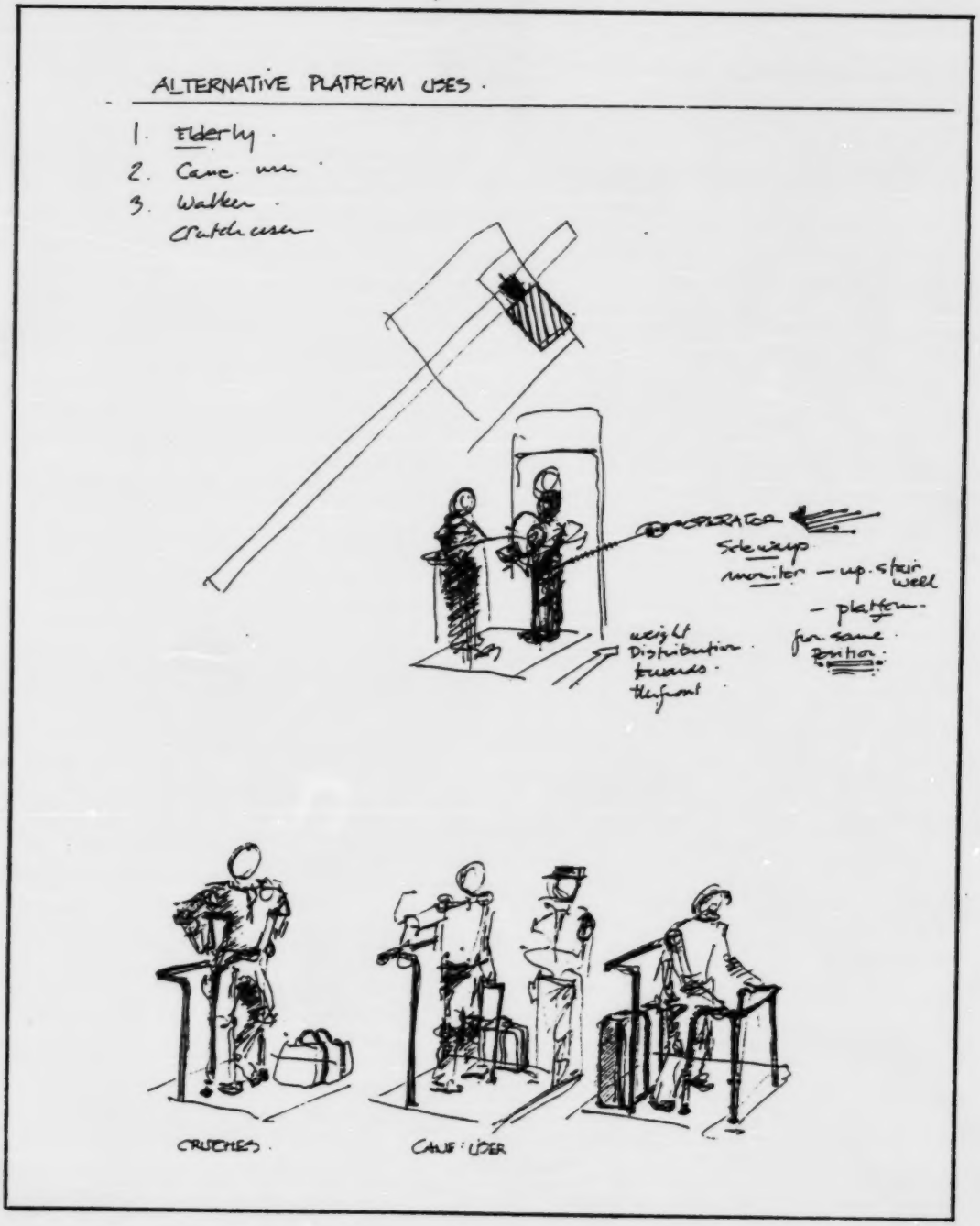

Fig. 5 Platform users

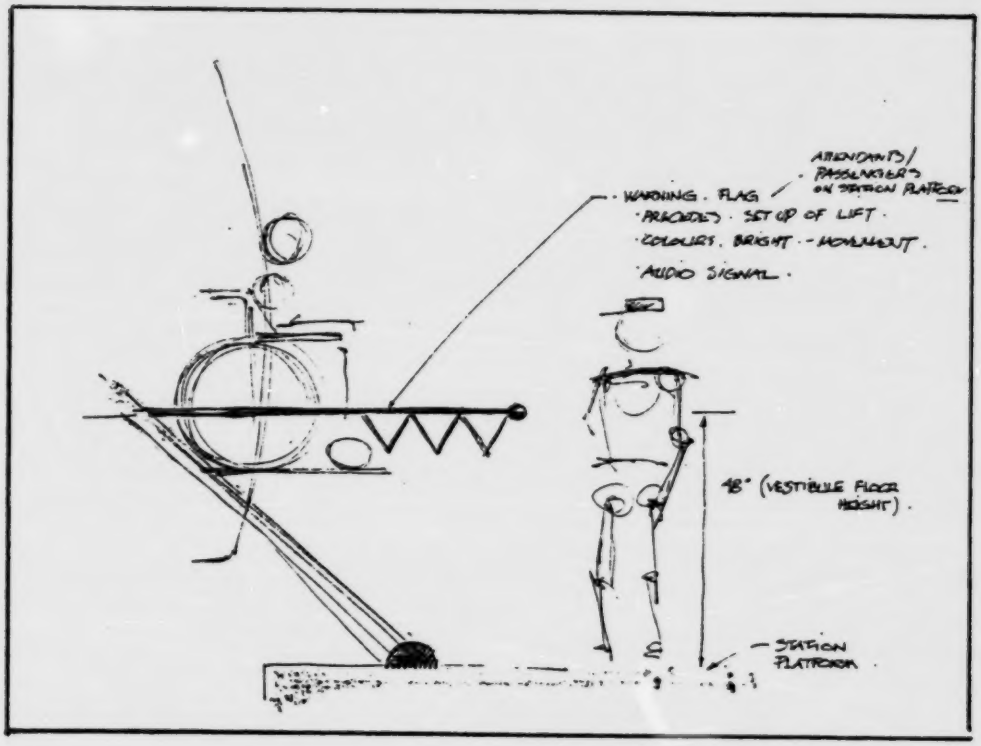

Fig. 6 Design sketch of lift principle

6.0 DESIGN OF CONCEPT

With the established characteristics and requirements in mind, the design team of RUTENBERG DESIGN INC. set out to develop a number of concepts based on its original principle. The first was to establish a matrix of all requirements according to the different operations involved (shown following this section).

The feasibility study on storage areas had indicated that in most cars two alternatives for storage were available, either within the vestibule or behind the bulkhead. Only in the RDC cars it would not be allowed to store the lift in the vestibule. Proposed storage in the vestibule of the LRC revealed that the lift would have been stored in the following car adjacent to the accessible car, creating a logistical problem for many trains. Available vestibule spaces in the blue cars were not always the same or even symmetrical, which would have resulted in a variety of storage positions in different trains making it difficult for the agent to remember its location. Consistency is one of the most important aspects for such operations.

As requested by the design team, it was then decided by VIA to always make on all cars a similar position available, that is behind the bulkhead. Space availability was more generous, as anticipated in the beginning therefore eliminating the need in the design of the lift to cramp everything in a small box or dividing it into many small components. The bulkhead area allowed also for the possibility of storage of the lift on rollers, replacing lifting of the unit with pushing or pulling.

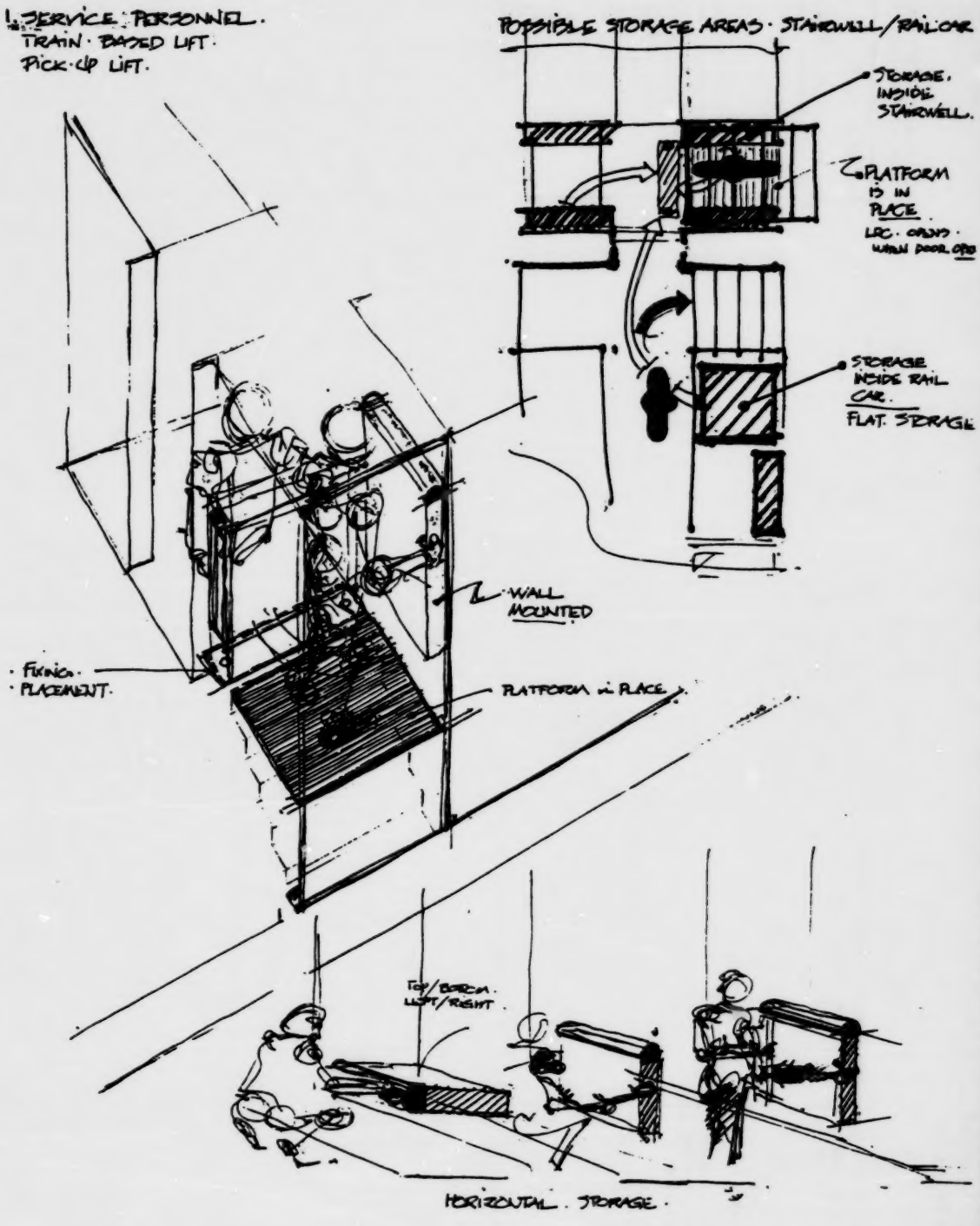

Fig. 7 Sketch, pick-up of lift

1. PICKING UP LIFT FROM STORAGE AREA

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
As much as possible is prepared by the operator before the train comes to a stop. Doors in the railcar are closed. Tasks are performed during the day, dusk and night, inside and outside of the passenger railcar. Weather conditions may require operator to wear extra clothing, heavy overcoats, boots, and gloves.	Not involved at this time.	Time required for tasks to be performed by operator and when to begin lift assembly before train stops. Handles, controls, switches must accomodate gloves		ELEVATING DEVICE STAIR PLATFORM LIFT means a stairlift equipped with a carriage (load carrying unit) in the form of a platform. STAIR PLATFORM LIFT TYPE D Stair platform lift where the runway isn't guarded. Runway: space within which carriage of lift moves. Platform: - flat, horizontal structure that is a part of the carriage - supports user(s). - wheelchair platform accomodates and supports only one handicapped person sitting in a wheelchair 3.8.1 LIGHTING 50 lux illumination - at drive unit - load carrying unit - landings
LOCATE STORAGE AREA		Close proximity to stairwell area. Identification, signage, clearly indicating location of the lift, as it will vary from railcar to railcar. - vertical, - horizontal storage	2.1.1 STORAGE "On board lift and attachments, space not to exceed 22" x 49" x 4.75"."	
REMOVE COVER		Tamperproof - protects lift from damage - passengers from any exposed components of lift		
RELEASE LIFT		Wheelchair lift is to be firmly secured to railcar until it is to be used. - easily released		
REMOVE LIFT		Clear indication of handles or other device to allow lift to be removed from storage area. Instructions showing proper removal. - correct stance - position of hands for maximum strength, minimum strain - handle height - weight maximum - minimum clearance area	2.0.9 OPERATING REQUIREMENTS "To facilitate storage, assembly and positioning of the lift, no one subassembly supplied may exceed thirty (30) lbs."	
POSITION LIFT IN STAIRWELL AREA		Directions, how to manouver lift to set up position; shortest distance, limited space for movement. Visual reference for proper and safe positioning of lift. Positive placement. Set up only one way. Clearly marked top & front of lift. Position in relation to top step. Centering in stairwell.	2.0.4 ENVIRONMENT "The lift...shall be able to withstand the occasional impact loading from a fall from the height of thirty (30) inches onto steel or concrete floor without permanent deformation or degraded performance (as the result of inadvertant dropping)."	

Fig. 8 Requirements for pick-up

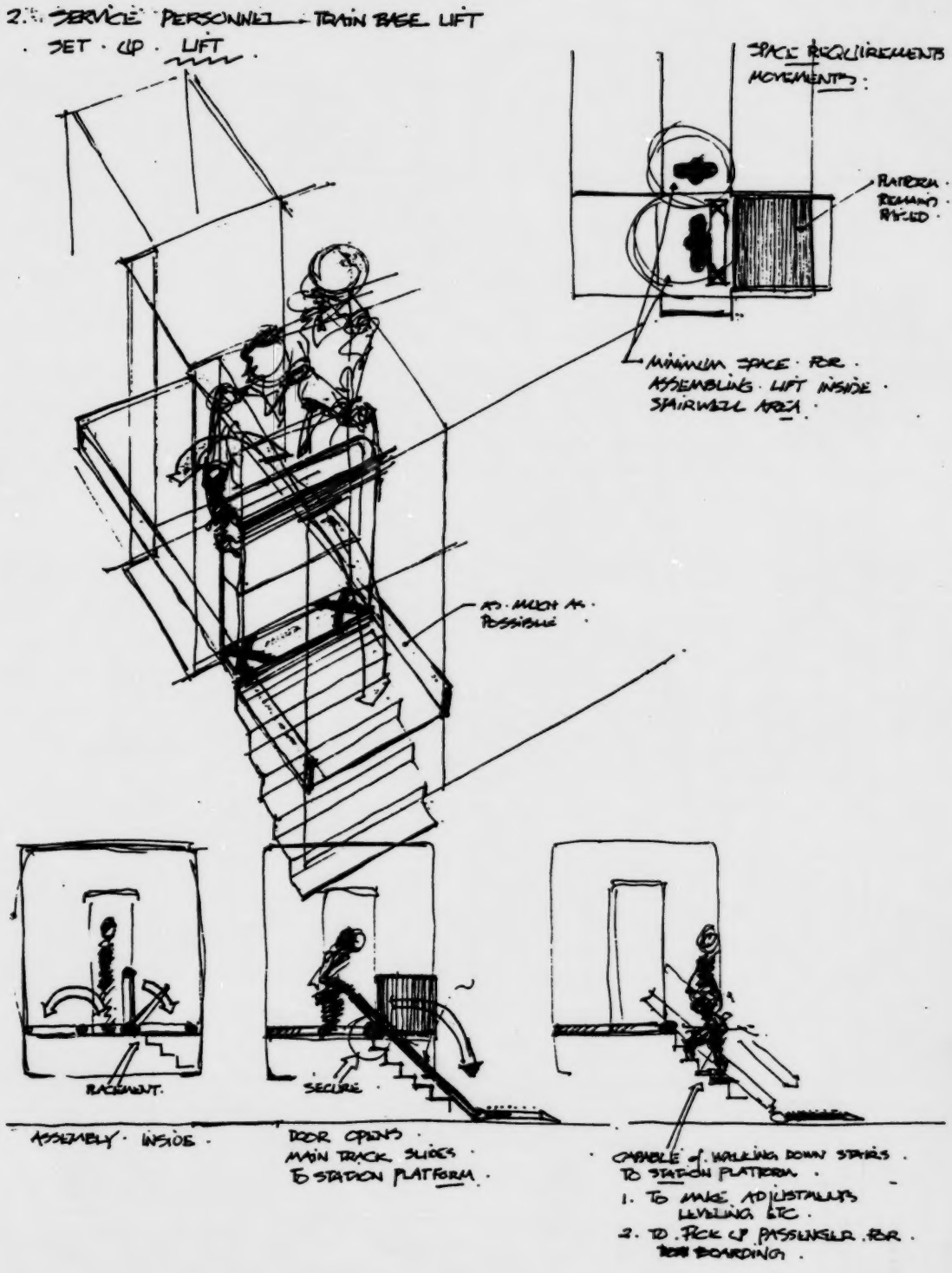
2. SERVICE PERSONNEL — TRAIN BASE LIFT
SET UP LIFT
SPACE REQUIREMENTS MOVEMENTS:
PLATFORM REMAINS RAISED
MINIMUM SPACE FOR ASSEMBLING LIFT INSIDE STAIRWELL AREA
AS MUCH AS POSSIBLE
PLACEMENT
SECURE
ASSEMBLY INSIDE
DOOR OPENS MAIN TRACK SLIDES TO STATION PLATFORM
CAPABLE of WALKING DOWN STAIRS TO STATION PLATFORM
1. TO MAKE ADJUSTMENTS LEVELING ETC
2. TO PICK UP PASSENGER FOR BOARDING

Fig. 9 Sketch, set-up lift

2. SETTING UP LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
PARTIAL ASSEMBLY IN STAIRWELL - train is still moving, door closed	Not involved at this time.	Graphic instructions for partial assembly. Lift should be secured to prevent movement. Unfold lift and lock components components together.	2.0.9 OPERATING REQUIREMENTS "Maximum allowable time for one employee to assemble the lift shall not exceed five minutes." "The maximum allowable time to: a) Position the lift (while train is stopped at the station) b) Affect a complete up & down cycle with rated payload and including loading and unloading c) Remove lift and prepare the vestibule for train departure Shall not exceed a total of two minutes." 2.0.5 POWER SOURCE - universal type - operating 110 V AC/DC - modified 64 DC - Maximum current draw not to exceed 12 amps. - power cable rated for outdoor 120 V, 20 amp service.	3.2.5 INCLINATION The mean angle of inclination of stair lift shall not be more than 45°. 3.2.32 LIMITS OF TRAVEL Surface of platform or footrest for stair need not be level with terminal landings.
COMPLETE ASSEMBLY - train stops, door opens, vestibule platform is raised. - wheelchair lift is lowered down stairway to station landing		Graphic instuctions for complete assembly. Platform & motor, control device part of assembly and firmly attached.		
PLUG LIFT INTO POWER SOURCE		Power source easily located on each train and clearly identified. Power cord not to interfere with movement of lift, attendant and passengers.		
ADJUSTING LIFT - ramps on platform are adjusted to meet different landings (vestibule & station)		Smooth transition between lift platform and vestibule, station landings, uneven surfaces. Raise/lower ramps from standing position, minimum effort to operator		
PLATFORM POSITIONING - platform is positioned and prepared to receive passenger When passenger is leaving train, platform is moved to top of lift. When passenger is boarding the train, platform is moved to the bottom of the lift.				
DESCEND STAIRWELL - to pick up passenger - for final adjustments, securing lift, leveling lift for stability		Operator able to descend stairwell to station landing.		

Fig. 10 Requirements, setting-up lift

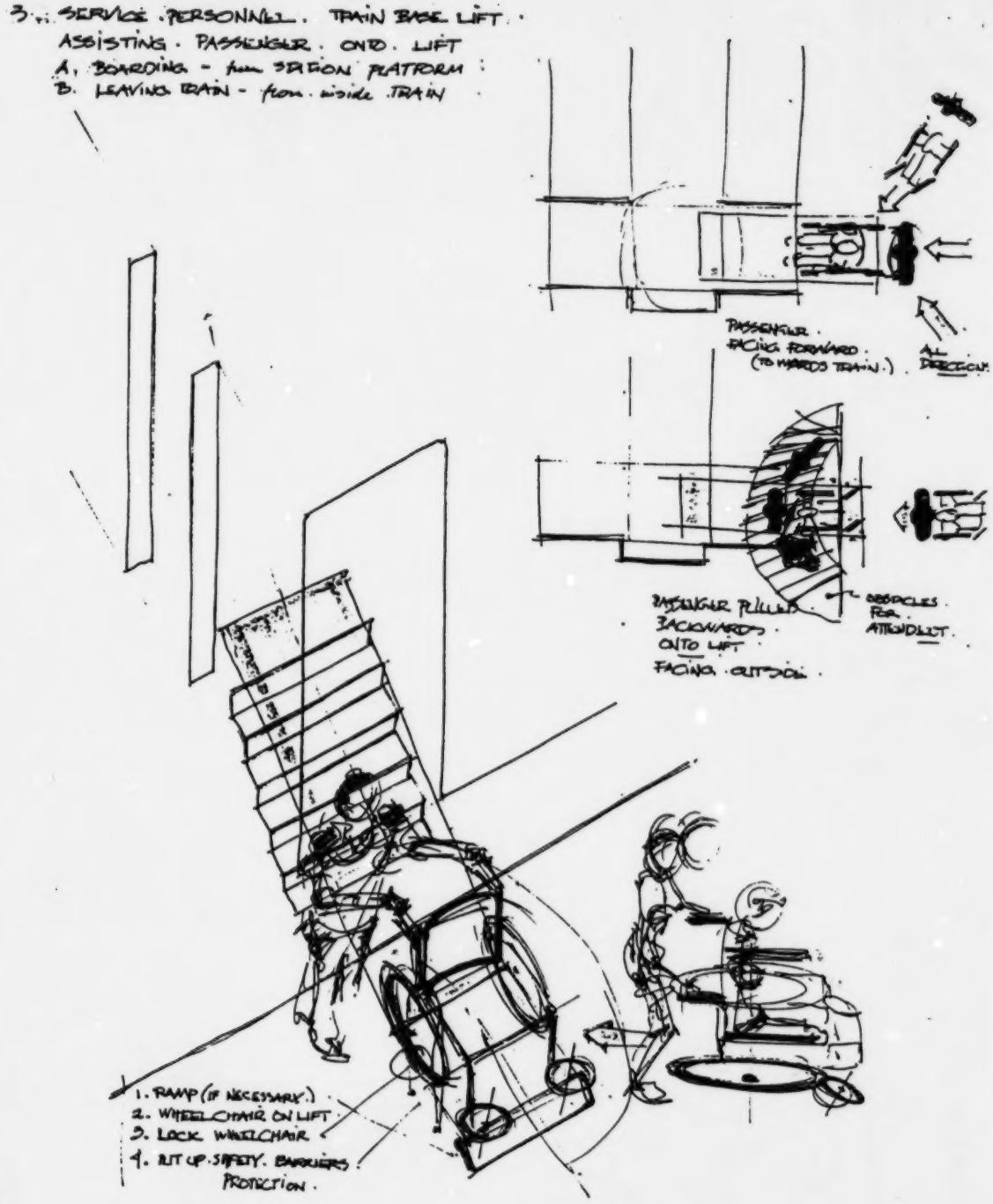
3. SERVICE PERSONNEL. TRAIN BASE LIFT.
ASSISTING PASSENGER ONTO LIFT
A. BOARDING - from STATION PLATFORM
B. LEAVING TRAIN - from inside TRAIN
PASSENGER FACING FORWARD (TOWARDS TRAIN)
ALL DIRECTION
PASSENGER PULLED BACKWARDS ONTO LIFT FACING OUTSIDE
OBSTACLES FOR ATTENDANT
1. RAMP (IF NECESSARY)
2. WHEELCHAIR ON LIFT
3. LOCK WHEELCHAIR
4. LIFT UP. SAFETY BARRIERS PROTECTION

Fig. 11 Sketch, assisting to left

3. ASSISTING WHEELCHAIR USER ON TO THE LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
DEBOARDING: When passenger is leaving the train, the operator assists passenger on to lift at top of stairwell. Operator picks up passenger from seat, brings them down the aisle, through the narrow passageway into the stairwell area.		Visual appearance should indicate safe, strong, sturdy and capable of lifting a wheelchair passenger. Stigmatized, crude, clinical appearance should be avoided. Should not intimidate passenger as well as attendant.	2.0.3 WHEELCHAIRS "Three and four wheeled manual and motorized wheelchair payload together with attendant/ 650 lbs."	3.5.2 CAPACITY & RATED LOAD "Where mass of wheelchair exceeds 70 kg minimum rated load of platform designed to carry wheelchair shall be increased accordingly." Types: wheelchair platform/ wheelchair and attendant platform (Type D stair). Maximum capacity - one person & wheelchair / two persons & wheelchair. Minimum size - 700 mm width / 800 mm width. - 1 100 mm length / 1 600 mm length. Maximum area - 1.20 sq. m/ 2.00 sq. m. Minimum rated load - 185 kg / 250 kg. 3.6.1 SAFETY FACTOR "Not less than 5 for all parts of the equipment." 4.2.3.1 DOOR/GATE INTERLOCK a) prevent operation unless door/ gate is locked in closed position b) prevent opening of door/gate unless within 50 mm of landing side 4.2.1 LANDING DOORS/GATE a) self closing maximum force 40 N to open
MANOUVER PASSENGER ONTO LIFT - operator wheels passenger so that passenger is facing toward the outside (preferred)	Passenger is always assisted by operator. Passenger should be made to feel comfortable and secure.	Graphic instructions: Movement of wheelchair passenger through train to stairwell. Limited space for manouvering. Smooth movement from landing to platform lift, solid fixing to lift, level position of wheelchair. Platform requires devices: - for centering wheels - adapting to various wheel chair sizes - Stops (fore & aft positions) - Adjustment for angle of inclination & levelling		
SECURE WHEELCHAIR TO LIFT		Lock - minimum force - positive - no movement to sides - no rolling forwards or backwards Storage on lift for hand luggage, handbags, canes, crutches, etc.		
SET UP SAFETY BARRIERS - raise ramps	Safety barriers required to provide protection as well as feeling of psychological well being.	Minimum effort to engage safety barriers. - barriers to protect front & sides of passenger while on lift Lift not to operate until wheelchair and safety barriers are properly secured.		
BOARDING: When the passenger is boarding the train, the operator assists the passenger onto the lift at the station landing level. Manouver passenger onto the lift. SECURE WHEELCHAIR TO LIFT SET UP SAFETY BARRIERS	Same requirements as for deboarding.	Same requirements as for deboarding		

Fig. 12 Requirements, assisting to lift

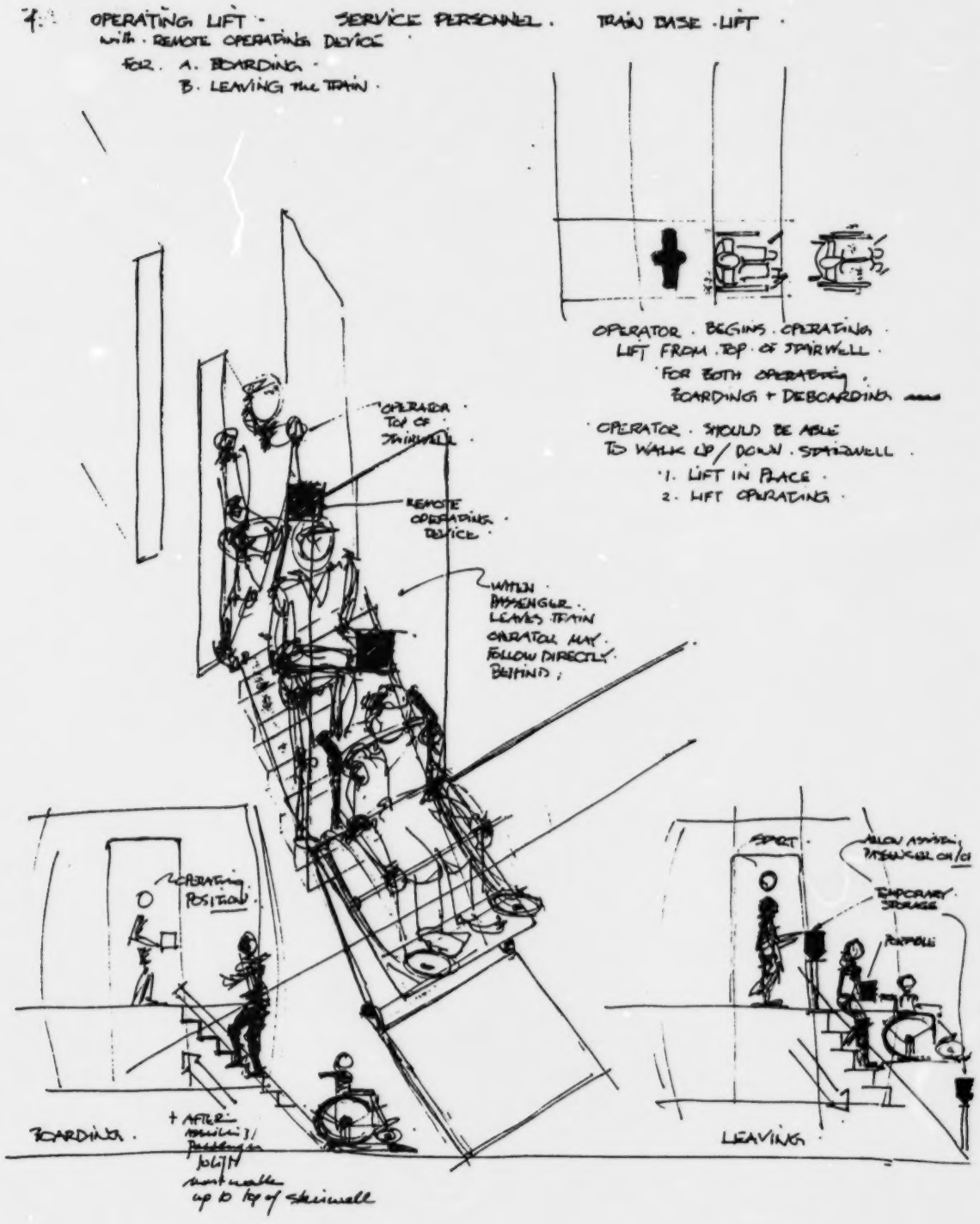

Fig. 13 Sketch, operating lift

4. OPERATING LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
Passenger is in constant view of the operator	Ideally passenger should face direction of movement for a more secure feeling. Ascending - towards train (preferred) Descending - away from train	Passenger should have no control over movement and operation of lift.		DRIVING UNIT 3.3 Rated speed shall not exceed 0.15 m/s. 5.2.2.1 Gearing safety factor a) 8 for steel, bronze b) 10 for cast iron 5.2.3.1 Driving machine brakes provided with a means of braking 125% Rated load to smooth stop within a distance of 20 mm and held firmly in position. EMERGENCY SITUATION 5.2.4.1-5 Moving of carriage in case of EMERGENCY.
LOCATE CONTROL DEVICE		Controls to require hand operation (left & right handed) can be operated while attendant is wearing gloves. Not to interfere with movement of lift. Accessible. Proper height and angle.	2.0.6 REMOTE CONTROL BOX - control from car vestibule or from trackside - continuous spring loaded - weather resistant and colour coded push buttons - bilingual - release of contact interrupts power	
CHECK STATUS - power on - lift locked - wheelchair secured	Wheelchair and passenger are secured to lift.	Placement, colour and size. Controls & switches determined by priority & sequence. Visual, audio tactile feedback.		
CHOOSE DIRECTION OF MOVEMENT (up/down)		Position of directional switch to correspond to movement of lift.		
ACTIVATE LIFT (go/stop) When cycle is complete, lift automatically stops	"Quality of ride on wheelchair lift is determined by speed, acceleration, vibration, and noise level."	Lift operates by activating one control, automatic stop when control switch is released (dead man switch). Ride quality: operation should be smooth, steady movement, avoid sudden jerks, stopping gently. No sway of platform, platform level while moving. Auto stop microswitch control (car vestibule & station landing position). One speed. Position of controls allow operator hands-free to assist passenger to and from lift as necessary.		
EMERGENCY - power failure - cord accidentally unplugged - malfunction in the lift	Passenger to remain in wheelchair.	Instructions, procedure. No movement permitted in platform when there isn't any power. Manual override. Accessible hand tool. Minimum effort/time required by operator to bring passenger to landing level. Lift automatically shuts off. When power is restored platform does not accidentally move on lift.		

Fig. 14 Requirements, operating lift

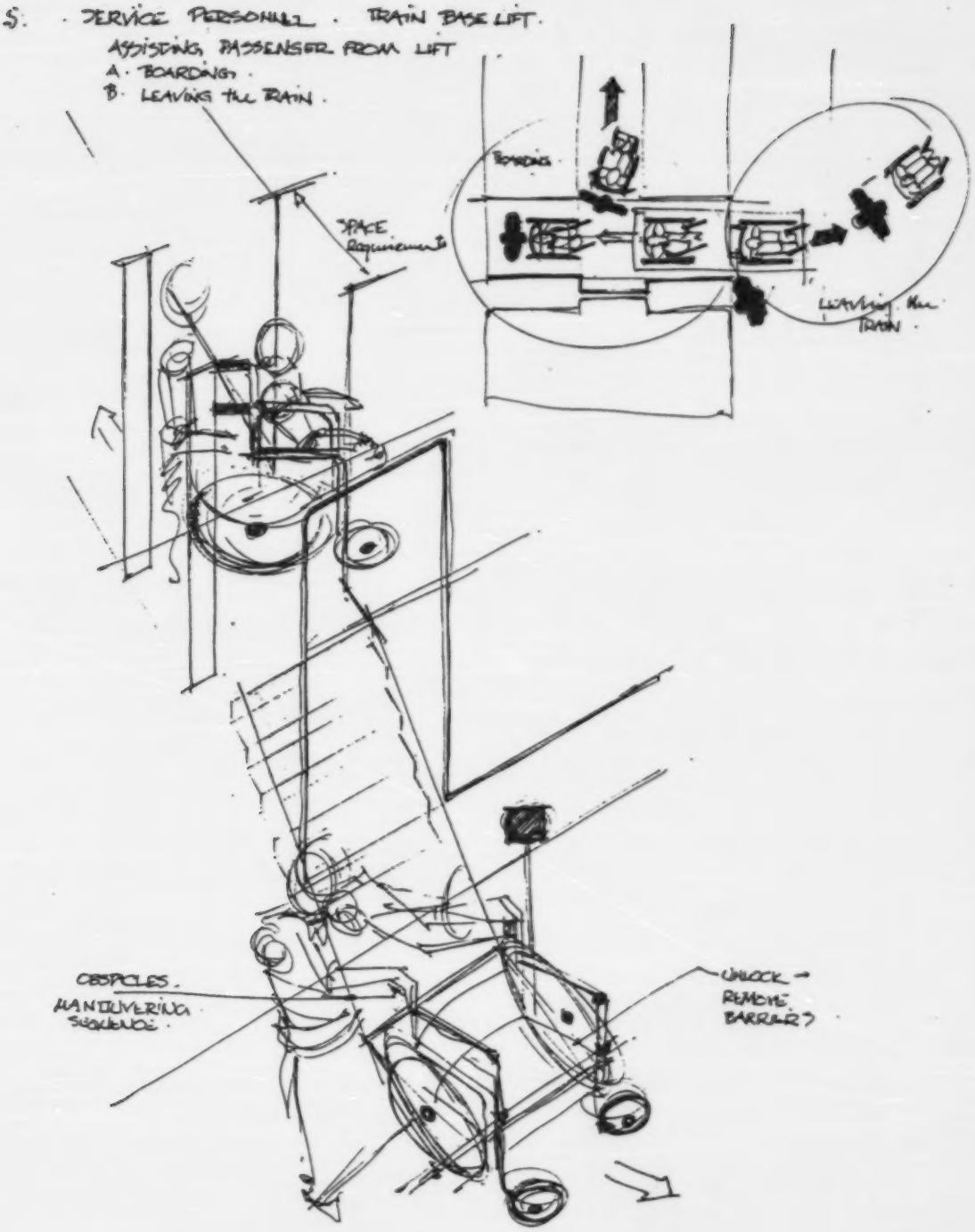

Fig. 15 Sketch, assisting from lift

5. ASSISTING WHEELCHAIR PASSENGER FORM LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
DEBOARDING: Operator assists passenger from lift to the train station platform.				
PREPARE LIFT PLATFORM - lower ramps - remove safety barriers - unlock wheelchair	Operator is within passenger's personal space, minimum physical contact to passenger is maintained throughout procedure.	Graphic Instructions: Operation of ramps, locks, safety barriers. Standing position for operation. Accessibility from either vestibule or station landing.		
MANOUVERING PASSENGER FORM LIFT Wheelchair handles are used to manouver seated passenger onto station platform		Graphic Instructions: How to manouver seated passenger onto station platform.		
BOARDING: Operator assists passenger from lift inside the train at the top of the stairwell.				
PREPARE LIFT PLATFORM - lower ramps - remove safety barriers - unlock wheelchair	Same requirements as for deboarding.	Graphic Instructions: Same as above. Operator has less space to manouver at sides and front of platform.		
MANOUVERING PASSENGER FORM LIFT PLATFORM Wheelchair handles are used to manouver seated passenger into aisle and towards train seat.		Graphic Instructions: Move passenger from lift. How to manouver seated passenger towards seat.		

Fig. 16 Requirements, assisting from lift

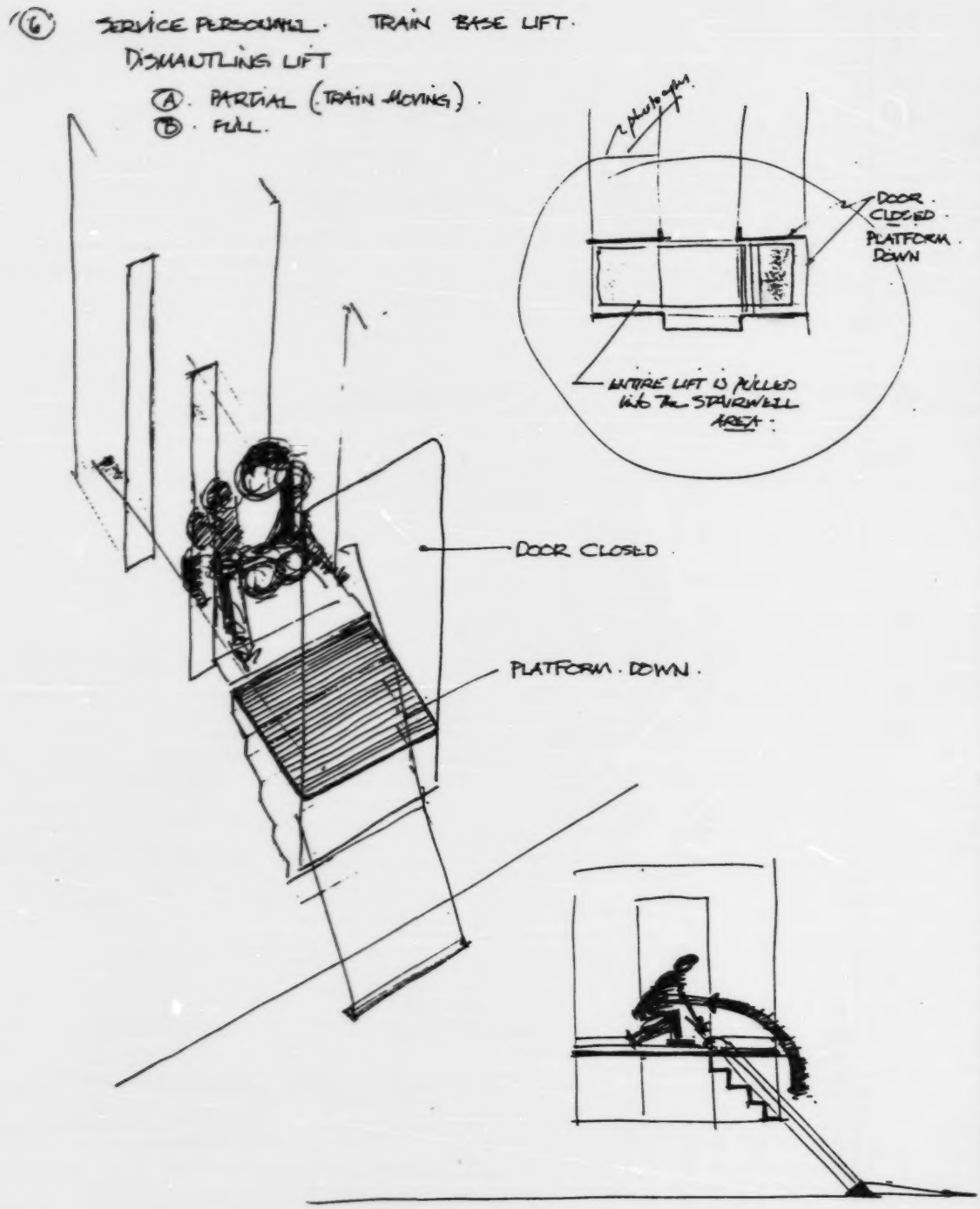

Fig. 17 Sketch, dismantle lift

6. DISMANTLING THE LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
UNPLUG LIFT FROM POWER SOURCE	Not involved	POWER PLUG/CORD - positive socket - easy to grip - cord storage provided		
PARTIAL DISMANTLING OF LIFT - lift is pulled inside train onto the vestibule - train door is closed, vestibule floor is replaced - train begins rolling		Graphic instructions. Simple dismantling. Minimum strength required by operator. No sharp edges. No exposed moving parts. No exposed greasy surfaces. No traps for hands/fingers.		
COMPLETE DISMANTLING OF LIFT - takes place inside vestibule area		Platform & motor combined with lift assembly. Control device cord part of the disassembled lift package.		
CLEANING OF LIFT - lift components and exposed mechanisms should be wiped down if rain/snow/ice/mud present.		Design of lift and selection of finishes appropriate for different climatic conditions, ease of maintenance and service.		
RETURN LIFT TO STORAGE POINT		Clear indication of how to hold and position lift. Top and front of lift identified. Low centre of gravity to facilitate positioning for storage.		

Fig. 18 Requirements, dismantle lift

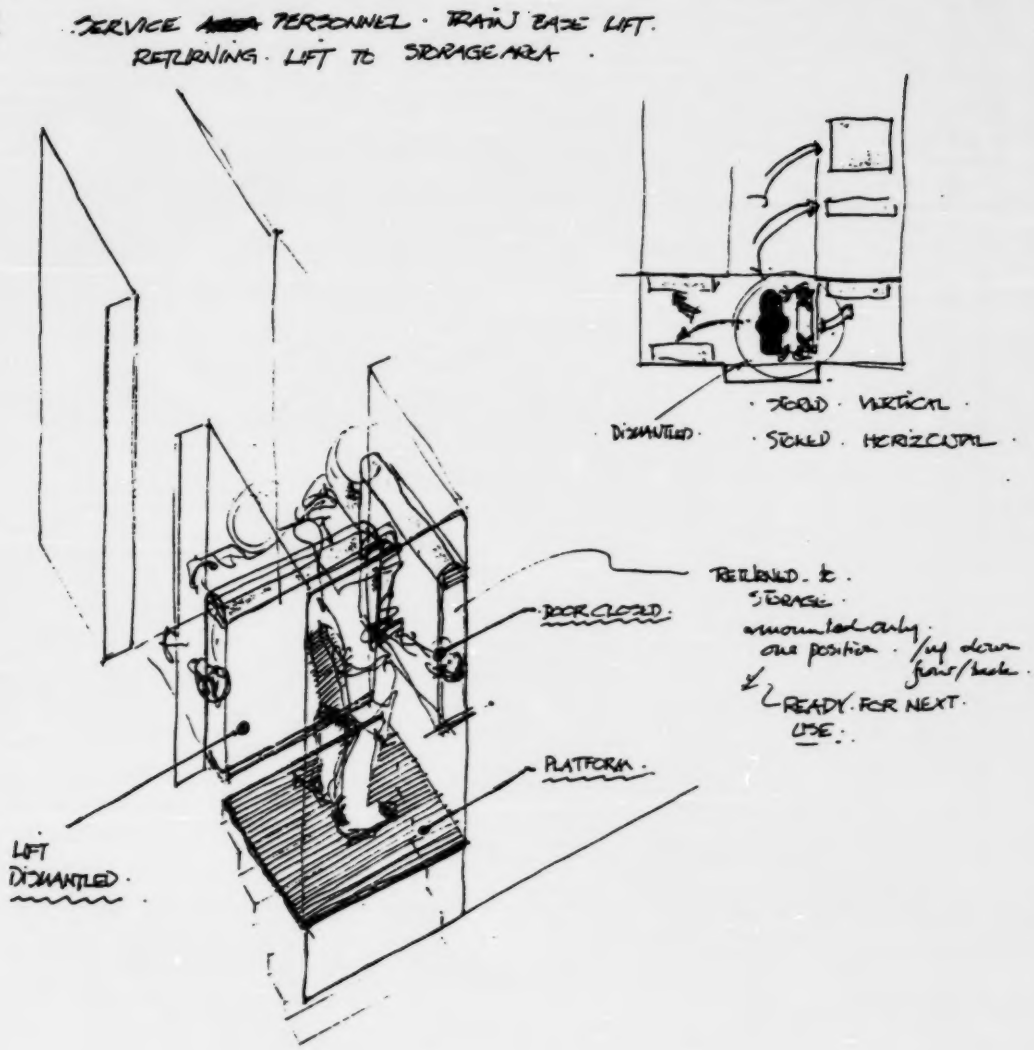
7. SERVICE PERSONNEL · TRAIN BASE LIFT.
RETURNING · LIFT TO STORAGE AREA ·
DISMANTLED
FOLD · VERTICAL ·
STORED · HORIZONTAL ·
RETURNED · to · STORAGE · mounted only one position · fwd down feet/brake ·
READY FOR NEXT USE ·
DOOR CLOSED
PLATFORM ·
LIFT DISMANTLED ·

Fig. 19 Sketch, storage of lift

7. STORING LIFT

OPERATOR	PASSENGER	PRODUCT REQUIREMENTS	TECHNICAL REQUIREMENTS (VIA)	SAFETY CODE FOR ELEVATING DEVICES FOR THE HANDICAPPED (CSA)
STORE LIFT	Not involved	Clearly marked handle or other positioning points used by operator to facilitate storage. Only one possible way for correct, SAFE storage. Storage area is clearly identified and at standard location(s) in all railcars. Indication of storage location(s).		
SECURE AND LOCK LIFT		Positive locking of lift to wall for vertical storage and/or horizontal storage. No movement and/or vibration when train is rolling.		
COVER LIFT		Protective cover - visible - tamperproof - protects lift - protects passengers, personnel from exposed components.		

Fig. 20 Requirements, storage of lift

6.1 Design Approach I

The original idea was to have two foldable beams placed on the extreme left and right side in the stairwell, using the stairs as the support and having a power platform moving up and down.

The advantage of such an approach was the clearance in the center of the stairwell for the agent to walk in front or behind the platform when ascending or descending and the need for an additional supportive structure which makes existing designs heavy, bulky and difficult to maneuver.

The problem with that approach was mostly of a technical nature. A double synchronized cable or chain drive system would be expensive. The irregularity in the station platform surface would require an independent, automatic levelling system at the end of each beam, or a time consuming adjustment by the agent.

From a technical side the following components were analyzed and evaluated as the most significant ones in the development:

1. Main rails
2. Power system
3. Platform size
4. Stored lift size and height
5. Lift platform main rail interface
6. Main rail/train car interface.

1. Main Rails

Two rails offer high torsional stablility using relatively small members. They also provide a better perceived safety factor for the user.

The main rail size for a payload of 227 kg (500 lbs.) previously based on 295 kg (650 lbs.) 216 cm (85") long rails and 30° inclination angle would be 38 mm x 75 mm x 6 mm (115" x 3" x .125") hollow rectangular tubing. This would provide: safety factor 185 kg (408 lbs. CSA) 5.38

safety factor 295 kg (650 lbs. VIA) 3.37

maximum deflection 295 kg (650 lbs. VIA) = 0.100"

The weight of the rails would be approximately 27.3 kg (60 lbs.) for two 2.13 m (7') lengths with a 90 cm (3') cross brace. The weight of the complete final rail assemby would likely reach 36.4 kg (80 lbs.) or more, once hinges, hardware and power system components are added (motor excluded). VIA's weight requirements could only be met by breaking the rails into smaller components.

2. Power System

The most promising system would likely be a cable/drum type, maybe a rack/pinion or feed screw mechanism would also be fairly suitable. Rack/pinion and cable/drum offer advantages in a two rail system to be synchronized.

To raise the required payload at the maximum allowable rate of 0.49"/sec., the power requirement is approximately 3/8 - 1/2 HP, with a safety factor of 2 and a conservatively assumed friction co-efficient of 0.5 on the platform/rail sliding mechanism. High reduction ratios would be necessary for a typical 110 V AC motor with 1750 RPM and require a gear box.

3. Platform Size

In order to accommodate most current wheelchairs a platform size of approximately 84 cm (33") wide and 106 cm (42") long would be necessary. The smallest available clearance in RDC's and blue cars is a width of 64.8 cm (25.5"), therefore limiting the platform to a maximum of 63.5 cm (25") or requiring that modifications to the trains are made to increase this dimension.

4. Stored Lift Size and Weight

Based on the existing preliminary concept of the lift, the total weight would be in the order of 68 kg (150 lbs.). To meet the VIA Rail requirement of 13.6 kg (30 lbs.) or less for any assembly, 5 or 6 assemblies would be necessary. This will complicate lift assembly, disassembly for storage, as well as increasing the time requirements for both operations. The major assemblies would likely consist of the platform, rail or rail assembly, power system and motor, control unit and wiring, and a trolley structure.

5. Platform/Rail Interface

The primary function of the trolley is to transmit all vertical and longitudinal torsinal loads to the main rails, and provide absolute positioning of the platform while allowing longitudinal motion along the rails. Therefore the trolley must have a finitive length along the rails to support guide rollers or pads, typically on three sides of the rails, which will adequately restrain the torsional loads along the rails due to any eccentricity in the center of gravity of the platform load. The term "adequately" is meant to imply that deflections must be quite minimal so that no noticeable "rocking" of the platform would

occur during boarding or load shifting on the platform.

The length of the trolley has to be compromised by the fact that it would create an increased height for the platform at the end of the beam at ground level which has to be overcome by a ramp to wheel the chair onto the platform.

6. Rail/Train Car Interface

This concept proposes one attachment point left and right in the stairwell which allows a positive positioning and protects the lift from disengaging in its operational position. The attachment is to allow longitudinal motion of the rails which can be located in any position so that a 45° angle can be maintained, regardless of the overall lift height required.

This idea simplifies the platform/rail interface which can be fixed at 45° to ensure that the platform is always level.

6.2 Design Approach II

This approach was based on the fact that weight of the main rails could be reduced substantially when using one rail only. This rail would be attached off center on one side of the stairwell. Unfortunately the platform, as well as the trolley, would have to be built much sturdier in order to resist torsional forces.

Many residential lifts are actually using this principle successfully, but are not restricted by time and weight factors.

6.3 Final Design Approach

During this development stage a number of criteria were changed as a result of consultations with VIA representatives. The most significant factor was the decrease of payload to 227 kg (500 lbs.) and an increase in the allowed storage space behind bulkheads. The direction which lead to the next approach was to develop essentially one large unit which will fold, roll along the floor and store vertically. The design would try to overcome the weight component requirement by sliding the rails, rolling the unit and use movements of the agent that would eliminate lifting as much as possible by using pulling, pushing, sliding and gliding forces. This approach would drastically reduce the amount of time necessary to assemble a variety of components and also require less expensive technical details and safeguards for individual components.

Based on these facts a central beam was developed which would fold in the center and accommodate the lift platform with a trolley. The trolley dimensions would enable the platform to reach ground level with a distance of only 10 cm (4") to be overcome. The central beam also has other advantages: it allows the lift platform to protrude towards the back into the beam, thus moving the center of gravity closer to the beam. The end of the beam which touches the ground level would not be subject to a two point height discrepancy on the ground. A central beam requires less lateral space for handling and maneuvering. The drive system consists of only one cable/drum without the need for synchronization. In order to provide lateral stability and decrease deflection this central open-to-the-outside beam would be a double beam, housing in one the electrical drive system and in the other

the manual back-up. Using aluminum channels, rails weight could be reduced to about 22.7 kg (50 1 bs.). A center hinge with reinforcement would provide adequate strength and alignment of the upper and lower rail sections. With these open channels the trolley can be easily incorporated into the platform since the rollers can be situated in a straight line across the top and bottom channel flanges. Eight rollers should be used in total, four per side, two per channel flange. The orientation of the rollers allows the platform angle to be varied (to compensate for rail angle changes due to floor/ground height variations).

6.4 Description of Final Design

Use

The folded lift with all its components is stored vertically, measuring 64 cm x 135 cm x 30 cm (25" x 53" x 12"). On casters it can be rolled out from its position behind the bulkhead into the corridor and further to the vestibule. Before arriving at the train station, the agent can partially unfold the beams, rolling the far end of the beam along the vestibule floor until the opening of the flip door. As soon as the train stops and the door is open, the beam can be completely unfolded on the vestibule floor and locked in its position. The agent then pushes the unit along the vestibule floor toward the open door, sliding it atop the stairs down to the ground. The far end of the beam can roll on the ground to adjust for any height changes, since the beam has a fixed length. The top end of the beam has a crossbar with adjustable ends which fit into holes on each side of the first stair and are locked in their position, only allowing pivot. The agent plugs in the power cord, located along the platform, into a power outlet in the vestibule area. The agent releases the hand control with the cord from the platform and hangs it on a hand rail. Using the foot, a spring releases the lift platform and brings it into its horizontal position. If a passenger deboards now, the agent walks on the platform first, swings out the guard/hand rail from under the platform, which protects the wheelchair and passenger from rolling off the platform and locks it into its position. The wheelchair passenger is then rolled on the platform facing outside. Once on the platform, the handbrakes on the wheelchair are set and rear stops on the platform put in position to

prevent the wheelchair from rolling back. Two side guards on the platform, left and right, prevent rolling off the sides. The wheelchair passenger is told to hold on to the handlebar in front of him/her, if able to do so. This action has two purposes, it gives the passenger the feeling of security to hold onto something substantial and forces him/her at the same time to bring in the elbows. This aspect is very important since clearance in the stairwell is very critical and the passenger could hit his elbows on the car handles. There is no room left to provide any other guard on the sides of the platform to achieve this goal.

The agent then picks up the hand control, positions himself in the vestibule and pushes the "down" button on the hand control. There are two buttons, one for "down", one for "up" with arrows and verbal identification. As soon as a button is released the lift will stop.

The lift then descends and a micro switch stops the platform when it reaches the ground, overriding the manual control. The agent can walk behind the descending platform, although the space left and right of the central beam is not as generous as in a two-beam approach.

Once on the ground the agent walks to the front of the platform, releases the hand/guard rail and brings it into its stored position underneath the platform. He then pulls out a ramp which allows him to roll the wheelchair passenger off onto the station platform level.

If no other wheelchair passenger is boarding, the agent takes the hand control, walks up to the vestibule and ascends the platform behind him until it reaches its highest position level (with vestibule floor).

By pushing down with the foot on the release, the platform is brought into the storage position parallel to the rails. The power plug will be disconnected, as well as the crossbar attachments, and is then pulled up along the top of the stairs in order to close the train door for the train to leave the station. All other operations, eg. folding the beam completely, storing hand control and power supply cord, can now be done in the vestibule area by the agent while the train is moving.

Once the unit is ready for storage it will be rolled back into the storage position behind the bulkhead and locked in a box provided by VIA. Boarding is the reverse procedure starting from the ground level.

7. BUILDING OF MOCK-UP

A total of 6 approaches were built in small scale model form until the final concept was selected. This concept was then first built in cardboard in full size and brought to various cars in the yards at Pointe St. Charles in Montreal to verify dimensions. Final dimensions for components were then determined as much as possible at this point.

Preliminary shop drawings were made to build full-scale wooden mock-up which would simulate dimensions, volumes, color, shapes and some functional aspects, such as moving of the platform up and down the rails and folding of the beams. The platform was built to accommodate the weight of a passenger in a wheelchair to simulate access to and from the platform. The guard/handlebar and the ramp were made to move in and out of their respective positions. Motor, gearbox, trolley and other components were built to represent their volume.

The purpose of this concept model was fully achieved, since its appearance gave for the first time all involved parties a basis for valuable discussions and evaluations.

The appearance of the unit was designed with the target group requirements and VIA as the client in mind using the corporate color range of the company for its equipment: light grey, blue, yellow and black.

In the final design all controls and safeguards, which would be operated by the agent, were proposed in yellow as the most intense color, usings its powerful attentive value.

Surface on the platform and the complete platform itself, was proposed in grey to make its appearance lighter. All structural elements, such as beams, carriage and crossbar are in blue and the motor in black.

The compact design conceals all moving parts as much as possible. It places the emphasis on operational and storage positions and on simplicity and order of components to form an integrated harmonious unit. Resemblance to any clinical,stigmatized or construction equipment was successfully eliminated according to some limited exposure to the handicapped target groups.

8. CONCLUSIONS

The development of Phase I has provided a full scale design concept, simulating functions and final appearance to its greatest extent.

This three-dimensional mock-up provided for the first time a realistic base for evaluations and discussions for the many departments

involved from VIA Rail Canada. As a result of this development many unknown aspects for the operation, the use and the application of the lift surfaced.

As it is the nature of a mock-up it also showed its limitations in assessing precise time-motion studies to verify the dwell time.

Among many others, two main aspects crystalized during the development, one the weight limitations for handling and two, the dwell time for boarding/deboarding. To meet both requirements with an equal priority, plus all technical and safety requirements, seemed an almost impossible task.

If the dwell time of 2 minutes in a station has to be met, there is no time to assemble a variety of components (apart from its technical complexity). If each component cannot require an effort of more than 13.6 kg (30 lbs.) to lift, pull, push or slide, the assembly time will increase and exceed 2 minutes.

A re-evaluation of priorities on VIA's side has to determine if both criteria have to be met equally and if so, which other criteria (technical, safety, equipment) can be changed.

One of the possibilities is to change the emphasis of the possible lift into a semi-portable one, where some of the components, eg. rails, drive units, etc., are built-in into cars and only the platform is engaged/disengaged and stored.

9. RECOMMENDATIONS

In order to proceed with the development of Phase II and Phase III the following is recommended:

1. Establish hierachy of priorities for operation, technical, safety and rolling stock.
2. Redesign concept with new criteria, for applicable cars.
3. Verify concept by modifying mock-up and simulating operation in cars.
4. Prepare preliminary drawings and build one functional prototype.
5. Test prototype and make changes if required.
6. Prepare technical drawings to be used for tenders.

10.0 Glossary of Terms

For the purpose of this study, the following simplification of car types was made, since the staircase and the vestibule area in many cars are the same and only the interior lay-out is different or consists of modifications, which would not affect the lift device.

LRC - New VIA fleet with wide doors and built-in foldable stairs.

RDC - Cars where engineer is sitting in vestibule area and storage is only allowed behind bulkhead. Staircase is exposed to weather. Exit door has flip door inside.

Blue Cars - Older type cars with protruding handles, flip doors, narrowest staircase and different lay-outs for dining, sleeping and snack bar. All types have some stairs and vestibule.

Stainless Steel Cars - Same as blue cars except for stainless steel finish in vestibule and staircase. Handle installation allow for more clearance.

Agent - The person who will be responsible for the handling of the lift.

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APPENDIX A: FIGURES, DESIGN & BUILDING

Fig. 21 Double beam concept

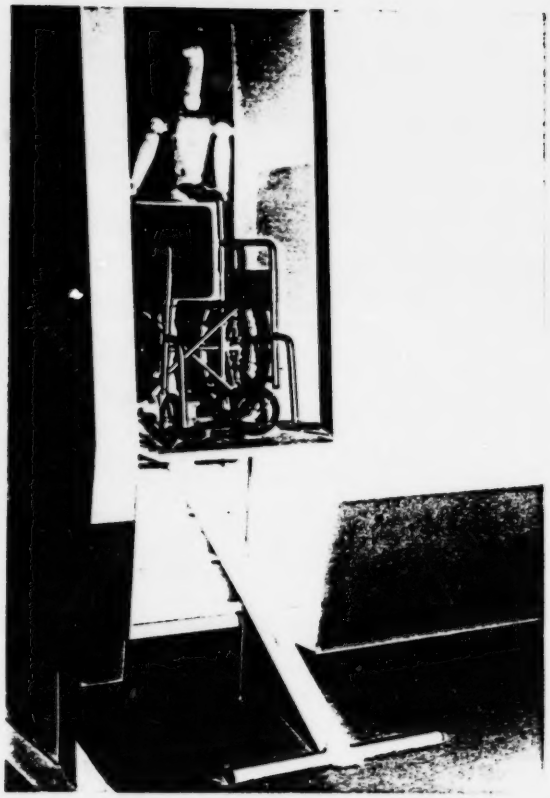


Fig. 22 Centre beam concept

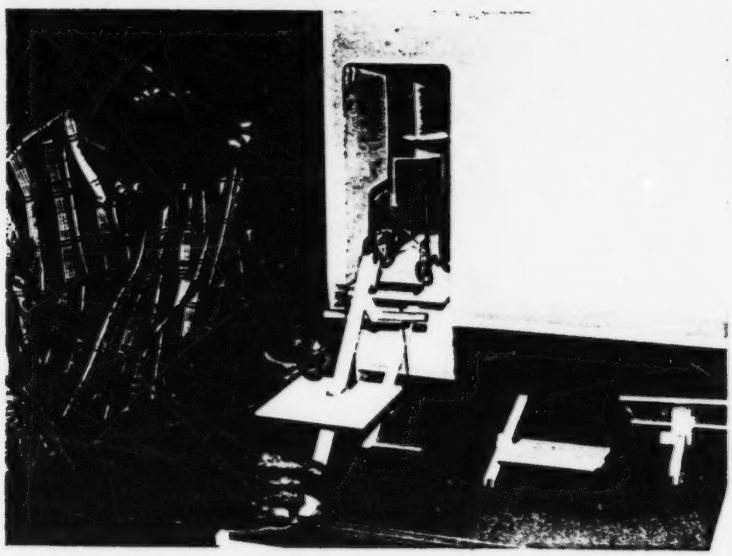


Fig. 23 Centre and off-centre concepts

Fig. 24 Verifying demensions on platform

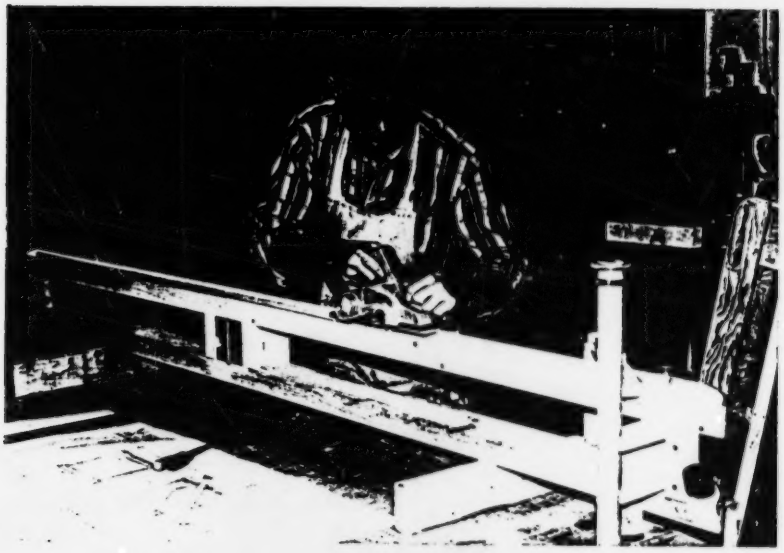


Fig 25 Building full scale beam

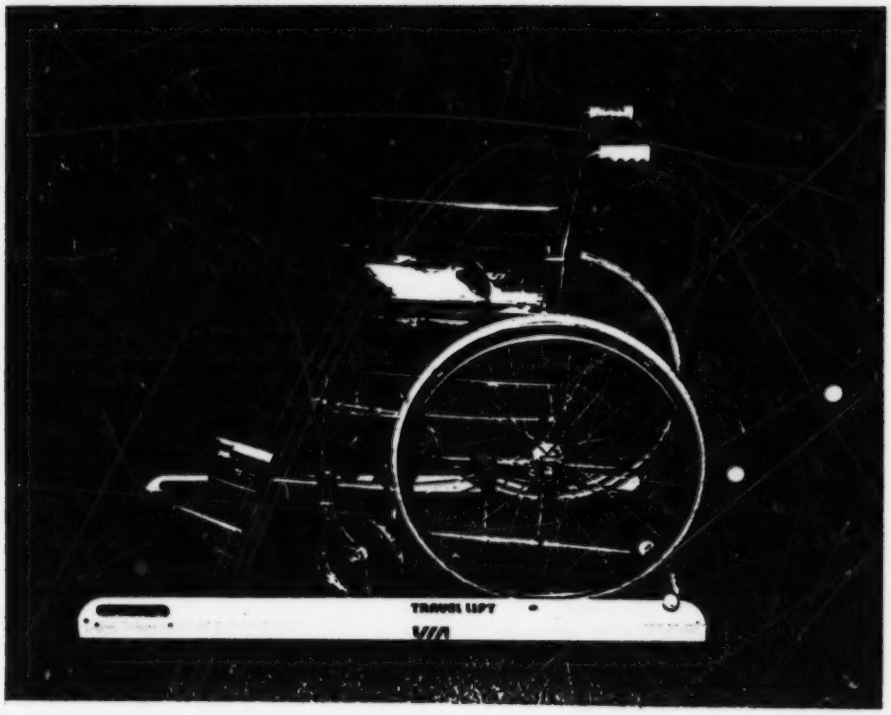


Fig. 26 VIA Travel lift mock-up

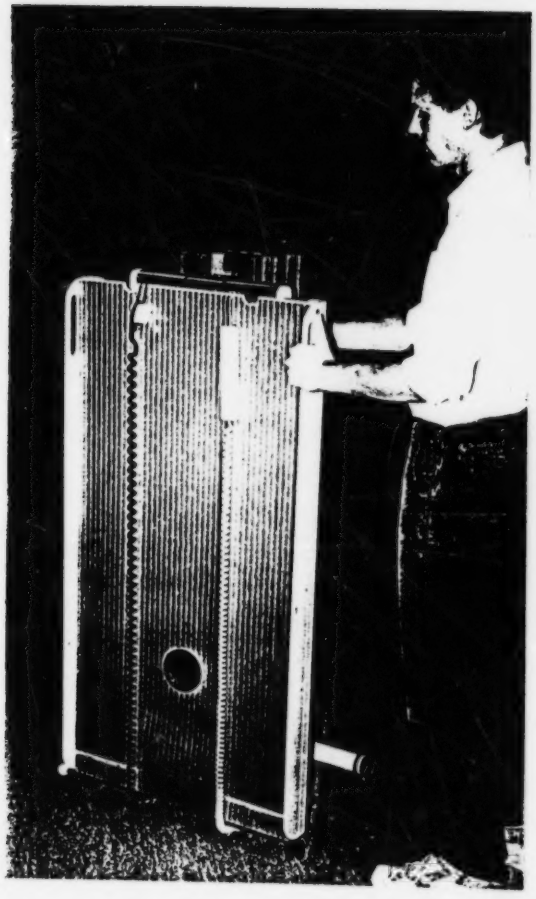


Fig. 27 Lift in stored position

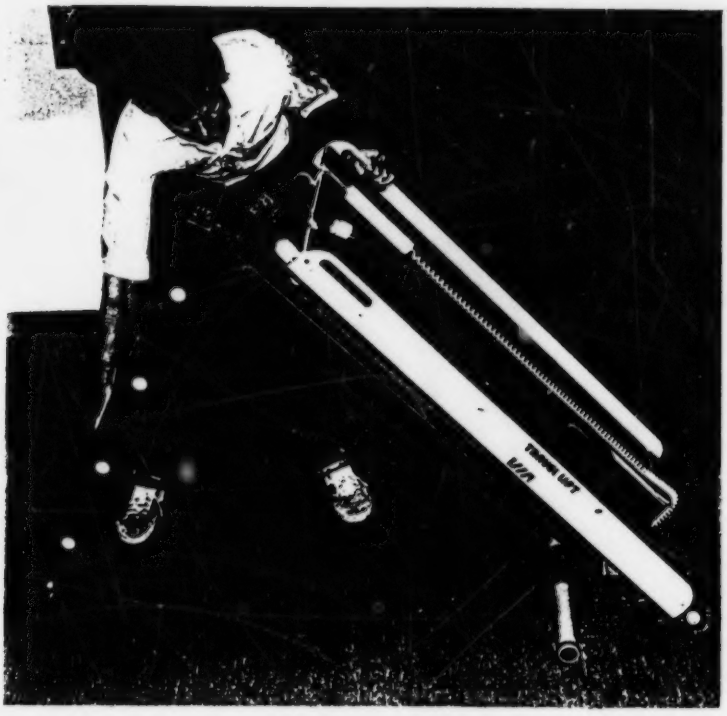


Fig. 28 Beam unfolding

Fig. 29 Beam completely unfolded

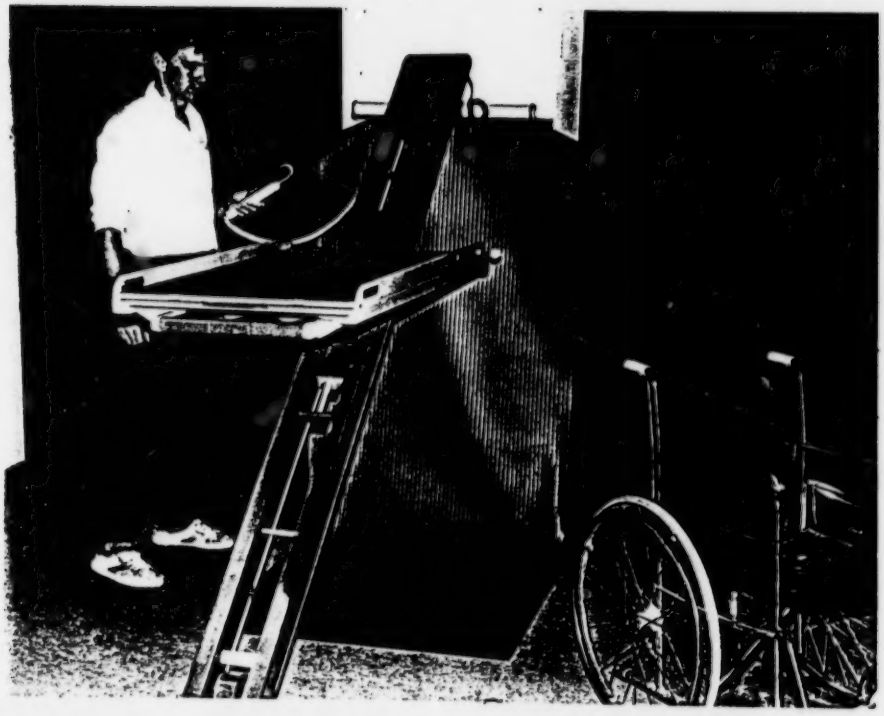


Fig. 30 Travel lift descending

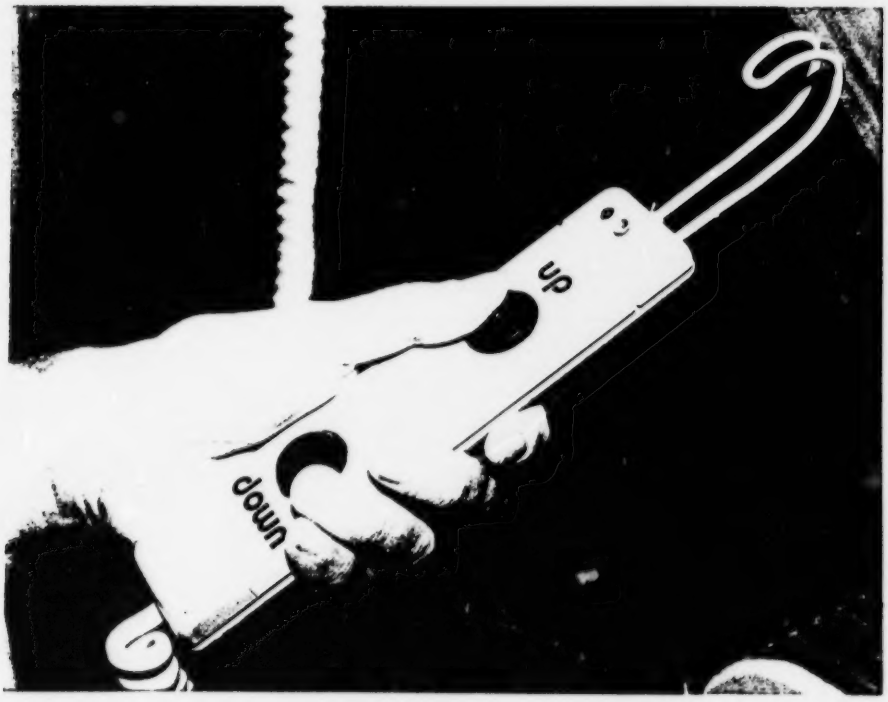


Fig. 31 Hand control mock-up

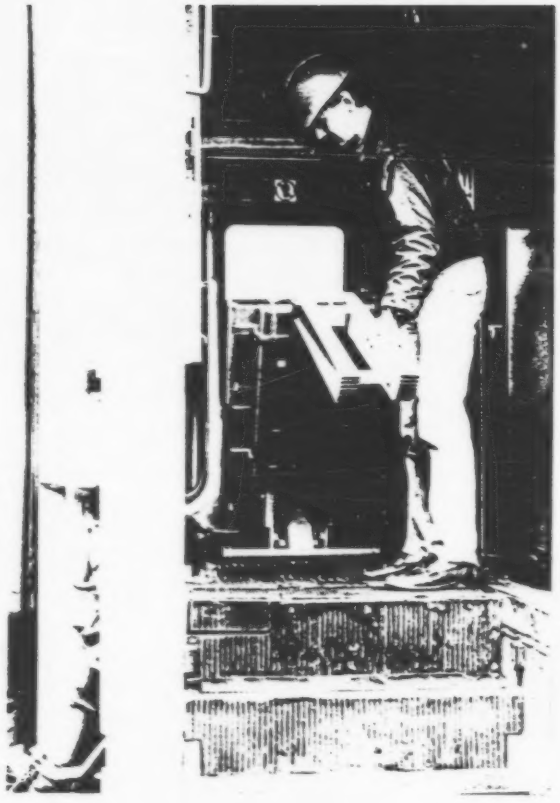


Fig. 32 Unfolding beam in LRC train

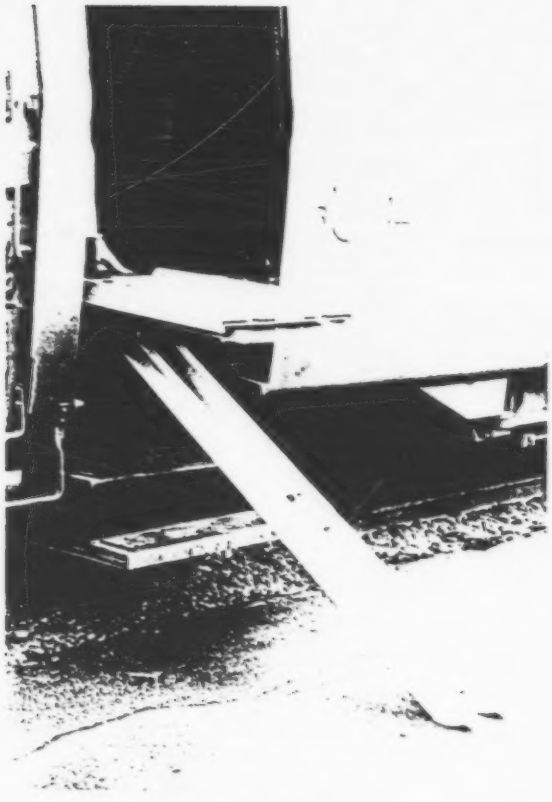


Fig. 33 Lift in working position

Fig. 34 Presentation of lift mock-up to TDC and VIA representatives

APPENDIX B: VIA RAIL REQUIREMENTS

2. TECHNICAL REQUIREMENTS

2.01 General

The design specifications consist of those in this Specification plus the attached drawings.

These Specifications are intended to be only a general guide to the function and purpose of the lift.

The overall quality of workmanship, fit and finish of parts shall allow the system to function smoothly and noiselessly, without excessive play or looseness and without tightness or binding. The dimensional tolerances have been left to the discretion of the Contractor, provided the functional dimensions are adhered to, and the machining, etc. shall be appropriate to the above requirements, and in accordance with good practice.

The lift shall be designed and constructed to provide long, safe and efficient operation outdoors, under all weather conditions.

2.02 Function

The purpose of this lift is to elevate or lower a handicapped passenger in a wheelchair from trackside to the vestibule floor level of VIA's passenger cars in a safe, secure, smooth and continuous motion.

2.03 Capacity

The lift shall be able to accommodate the range of three and four wheeled motorized and manual wheelchairs available together with an attendant. The payload capacity shall be six hundred and fifty (650) pounds.

It shall be capable of handling height differentials of up to sixty (60) inches (highest vehicle floor level to top of tie (TOT)).

2.04 Environment

The lift and its operation shall be unaffected by snow, salt or cold weather. During storage, it shall be able to withstand vibrations and shock loads as specified by VIA Engineering.

2. TECHNICAL REQUIREMENTS

2.04 Environment (Cont'd)

The lift, complete, and as subassemblies, together with its mechanisms, shall be able to withstand the occasional impact load resulting from a fall from the height of thirty (30) inches onto a steel or concrete floor without permanent deformation or degraded performance (as a result of inadvertent dropping).

The lift platform and tailgates shall be of an opaque or equivalent nature, slip-proof (even when wet) material.

2.05 Power Source

The lift shall be powered by a totally enclosed Universal type fractional horsepower motor capable of operating at 110 volts AC or DC. A similar or modified version of this motor shall also be provided for 64 volt DC operation. The maximum current draw including start-up shall not exceed 12 amps. The motor shall be capable of operating without damage with voltage fluctuations of up to fifteen percent (15%) and frequency fluctuations of up to ten percent (10%). The motor shall have thermal overload protection.

The power cable shall be rated for outdoor, 120 volt, 20 amp service, have a strain relieving connection to the control box and have a non-molded plug connector and cord length as specified by VIA Engineering.

2.06 Controls

There shall be a remote control box which shall permit operation of the lift from either the passenger car vestibule or from trackside. It shall have two continuous contact spring loaded weather resistant colour coded push buttons suitably bilingually labelled; on colours or signs to be agreed upon. Release of contact shall interrupt power to the drive motor.

The control system shall also protect the drive system from overtravel in either direction.

2. TECHNICAL REQUIREMENTS

2.07 Interface Requirements

The lift shall interface with the passenger car vestibules and stepwells as designated in Section 3 without imposing any structural modifications or undue stress on the car body. It shall remain rigid and immobile while the lift is in operation.

The method of interfacing with the vehicle shall be simple and straightforward to preclude any possibility of unsafe or potentially hazardous operation.

The lift shall accommodate uneven terrain and various degrees of car body cant.

It shall interface with the complete range of station platforms that VIA has (with the exception of Central Station, Montreal).

2.08 Codes

The lift shall conform with the following CSA Standards:

CAN 3-B355-M81 - Safety Code for Elevating Devices for the Handicapped

C22.1-1982 - Canadian Electrical Code

2.09 Operating Requirements

To facilitate storage, assembly and positioning of the lift no one subassembly supplied may exceed thirty (30) pounds.

The maximum allowable time for one employee to assemble the lift shall not exceed 5 minutes.

The maximum allowable time for one employee to

a. position the lift (while the train is stopped at the station),

b. affect a complete up and down cycle with the rated payload, including loading and unloading, and

c. remove the lift and prepare the vestibule for train departure

shall not exceed a total of 2 minutes.

2. TECHNICAL REQUIREMENTS

2.09 Operating Requirements (Cont'd)

The maximum allowable time for one employee to dismantle as required the lift and secure it in its storage position shall not exceed 5 minutes.

2.10 Anti-Rolloff Restraint Services

The lift platform shall provide safety features for the wheelchair to prevent it from rolling off and sliding off, ensuring also the safety feeling of the passenger sitting in it.

- belongings, accessories

2.11 Storage

The lift and all its appurtenances, either as an integral device or by means of assemblies shall be capable of being stored on-board the vehicle in a space not to exceed 22 inches X 49 inches X 4.75 inches.

2.12 Maintainability and Reliability

The vehicle based lift shall be designed to minimize maintenance costs and maximize reliability. The design shall be simple and contain a minimum number of different kinds of parts.

No part of the unit or its mechanism will require oiling, greasing, cleaning, or other preventative maintenance more often than once a year.

Parts that must be oiled, greased, or cleaned at regular intervals shall be minimized. All these parts shall be easily accessible and shall not be exposed to the passenger.

All mechanisms requiring adjustment to compensate for wear, shall permit the work to be made without disassembly of the unit.

Any repair or maintenance work shall not require the use of special tools.

Proven off-the-shelf parts shall be used to the greatest extent possible.

Parts requiring little or no maintenance shall be used as much as possible.

2. TECHNICAL REQUIREMENTS

2.12 Maintainability and Reliability (Cont'd)

The design must be extremely reliable, as it is going to be used mostly in remote areas, where no other means of boarding handicapped passengers are available. Most units will probably not receive any preventative maintenance. Thus, the ideal design will require no maintenance, as well as being 100% reliable.

2.13 Materials and Workmanship

2.13.01 Materials

The materials of construction shall be selected by the Contractor in accordance with the requirements of this Specification and the following criteria:

A. Corrosion resistant.

B. Easy to clean and repair. Special consideration shall be given to materials that do not require painting.

C. Lightweight construction.

D. All welding and fastening to be done in accordance with Canadian standards and requirements.

E. Any contact between dissimilar materials shall be treated in accordance with standard procedures.

2.13.02 Workmanship

The lift shall not have any sharp edges or protrusions which may cause injuries or damage to related equipment. The design of any moveable mechanisms (gates, draw bars, etc.,) shall prevent potential causes for injuries when being operated.

All metal forming shall be done with die or fixtures to assure uniformity of size and shape. Sheet metal or structural sections used in the fabrication of the equipment shall be smooth and even. Shearing shall be done accurately and present a neat finish.

2. TECHNICAL REQUIREMENTS

2.13.02 Workmanship (Cont'd)

Rivets, when used, shall be driven through completely filled holes with heads in full contact with the surface of the member. Holes for machine screws shall be drilled straight. All bolts, nuts, screws, etc. shall be drawn tightly and secured to prevent loosening under shock and vibration.

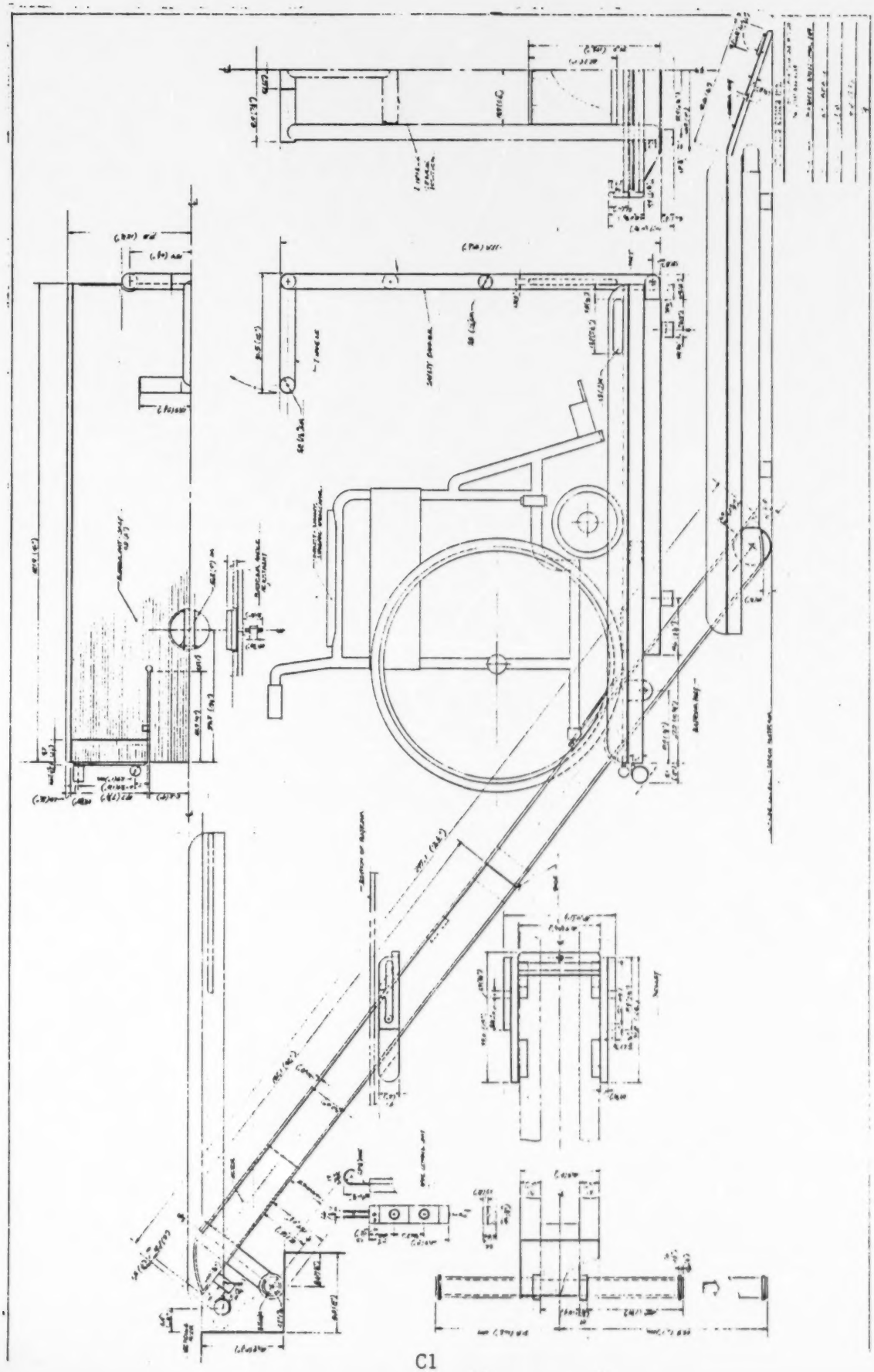
Any defects in workmanship and/or latent defects caused by design which are found to occur will be the responsibility of the Contractor and shall be corrected at no cost to VIA.

2.14 Standard Parts

The Contractor shall make every effort to use standard parts and components wherever feasible. As a minimum, the following items shall be standard:

- All fasteners
- Locking and/or latching devices
- Hinges
- Motors
- Control boxes

APPENDIX C: PRELIMINARY DRAWINGS



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APPENDIX D: PRELIMINARY SPECS

1. Preliminary Specifications

1.1 Stored position: 25" (63.5 cm) wide
12" (30 cm) deep
52" (1.32cm) high

1.2 Approximate weight: 150 lbs. (72 kg) on casters

1.3 Motor ½ HP AC/DC 110 Volt, 1800 rpm with gear box

1.4 Payload 500 lbs

1.5 Platform speed 0.5 feet/sec.

1.6 Hand control "up" and "down" safety switches, red light for operation

1.7 Safety factor 12 with double aluminium beams approximately 4" x 2"

1.8 Cable and drum drive with carriage under platform

1.9 Manual back-up: rachet and lever to gearbox

1.10 Safety back-up: inertia wheel on cable

2. Estimated operational time - from moment when train stops and doors are open.

	OPERATION	TIME in seconds
2.1	Unfold beam completely	8
2.2	Glide beam down stairs	7
2.3	Place crossbar in support	8
2.4	Release platform into horizontal position	2
2.5	Connect power plug	3
2.6	Drive platform down to station level and walk behind	14

2.7	Pull out ramp	3
2.8	Set rear wheel stops	3
2.9	Wheel passenger onto platform	10
2.10	Pull out front gate and secure in position	5
2.11	Walk up stairs to vestibule level with hand control	8
2.12	Drive platform up to vestibule level	14
2.13	Release rear wheel stops	3
2.14	Wheel passenger off into vestibule area	10
2.15	Unplug power plug	3
2.16	Disengage crossbar and pull up lift into vestibule	15
2.17	Fold beam in order to close train door	4
	TOTAL	120 sec.

Complete folding, bringing all components into storage position will take place when train is already moving.